

An updated checklist of blow fly fauna (Diptera: Calliphoridae) of Pakistan with new records for the country

¹Muhammad Asghar Hassan, ¹Imran Bodlah, ²Meenakshi Bharti* and ³Khalid Mahmood

¹ Department of Entomology, Pir Mehr Ali Shah Arid Agricultural University, Rawalpindi, Pakistan.

² Department of Zoology and Environmental Sciences, Punjabi University, Patiala, 147002, India.

³ Department of Entomology, Faculty of Agriculture, University of Poonch, Rawalakot, Azad Kashmir, Pakistan.

(Email: adubharti@gmail.com)

Abstract

An updated checklist of blow fly fauna of Pakistan is provided herewith. *Calliphora loewi* Enderlein, 1903, *Isomyia electa* (Villeneuve, 1927), *Lucilia calviceps* Bezzi, 1927, *Rhinia apicalis* (Wiedemann, 1830) and *Stomorphina xanthogaster* (Wiedemann, 1820) represent new records for the country. Now, the family Calliphoridae is represented by seven subfamilies, eighteen genera and fifty seven species from Pakistan.

Keywords: Calliphoridae, blow flies, check list, distribution, new records, Pakistan.

Received: 21 November 2017; Revised: 22 February 2018; Online: 27 February 2018.

Introduction

The members of family Calliphoridae (Diptera) represent cosmopolitan group of calyptrate flies, widely distributed in all of the zoogeographical regions of the world, encompassing 1450 described species clustered in 150 genera and 13 subfamilies (Tomberlin and Benbow, 2015). This heterogenous group of flies is of great significance in terms of medical, veterinary and economic concerns. Some of the species belonging to subfamily Calliphorinae, Chrysomyinae, Luciliinae and Toxotarsinae are well known for their potential to calculate post-mortem interval (PMI) in homicidal cases. On the other hand, few species of subfamily Bengaliinae, Ameniinae parasitize termites and ant nests, whereas species of *Protocalliphora*, *Trypocalliphora* and *Auchmeromyia* are hematophagous parasites of birds and mammals.

As per the earlier data, Senior-White *et al.* (1940) recorded 33 genera and 154 species from the British India (including Pakistan) and remainder of the Oriental region. Later, Nandi (2000, 2002), Bharti and Kurahashi (2010), Bharti (2011, 2012, 2014a & b, 2015, 2016), Bharti and Bunchu (2016)

and Bharti and Verves (2016) supplemented to the knowledge of Indian blow flies. However, for Pakistan, Kurahashi and Afzal (2002) reported forty eight species under eighteen genera. Of these, thirty seven species were new records for the country. Herein, we provide an updated checklist of Calliphorids of Pakistan including five new records.

Materials and Methods

For collection of blow flies, different regions of Pakistan were surveyed from 2015-2017. The adult specimens were collected from a variety of habitats (cow dung, horse manure, human excrements, garbage, trees, grasses, forest, wild flowers, animal meat and bones etc.) with the help of sweep nets. The specimens were killed with Potassium Cyanide fumes, subsequently pinned and kept in insect collection boxes. Taxonomic analysis was carried under Microscope CZM6 and images were captured on, Olympus SZX7. The identification was carried with the help of following literature: Senior-White *et al.*, 1940; Bharti and Kurahashi, 2010; Kurahashi and Bunchu, 2011; Bharti, 2014a, b; Setyaningrum and Al Dhafer, 2014; Yang *et*

al., 2014; Akbarzadeh *et al.*, 2015. Furthermore, some of the collected material was also compared with the reference collection housed in the laboratory of corresponding author at Department of Zoology and Environmental Sciences, Punjabi University Patiala, Punjab India. The identified specimens have been deposited at the Department of Entomology, Pir Mehr Ali Shah Arid Agricultural University, Rawalpindi, Pakistan.

Updated Checklist of Calliphoridae from Pakistan

Family: Calliphoridae

Subfamily: Ameninae

Genus: *Catapicephala* Macquart, 1850

Catapicephala pattoni Senior-White, Aubertin *et* Smart, 1940

Subfamily: Calliphorinae

Genus: *Calliphora* Robineau-Desvoidy, 1830

Calliphora chinghaiensis Van *et* Ma, 1978

Calliphora himalayana Kurahashi, 1994

**Calliphora loewi* Enderlein, 1903 Figure (C)

Calliphora uralensis Villeneuve, 1922

Calliphora vicina Robineau-Desvoidy, 1830

Calliphora vomitoria (Linnaeus, 1758)

Material Examined: Kashmir (Pakistan): Banjosa, 6000 ft, 1♂, 16.iv.2016, leg. M.A. Hassan. **New Record**

Distribution: China, India, Japan, Mongolia, Nepal and Pakistan.

Genus: *Cynomya* Robineau-Desvoidy, 1830

Cynomya mortuorum (Linnaeus, 1761)

Genus: *Onesia* Robineau-Desvoidy, 1830

Onesia menechmoides (Chen, 1979)

Onesia pamirica Rohdendorf, 1962

Genus: *Melinda* Robineau-Desvoidy, 1830

Melinda sugiyamai Kurahashi *et* Thapa, 1994

Melinda scutellata (Senior-White, 1923)

Subfamily: Luciliinae

Genus: *Hemipyrellia* Townsend, 1917

Hemipyrellia ligurriens (Wiedemann, 1830)

Hemipyrellia pulchra (Wiedemann, 1830)

Genus: *Lucilia* Robineau-Desvoidy, 1830

Lucilia ampullacea Villeneuve, 1922

Lucilia andrewsi (Senior-White, 1940)

**Lucilia calviceps* Bezzi, 1927 Figure (E)

Material Examined: Pakistan: Rawalpindi, 1600 ft, 1♀, 13.vi.2016, leg. I. Bodlah. **New Record**

Distribution: India, Malaysia, New Caledonia, Pakistan, Papua New Guinea, Philippines, Vanuatu Loyalty Islands.

Lucilia cuprina (Wiedemann 1830)

Lucilia fumicosta (Malloch, 1926)

Lucilia illustris (Meigen, 1826)

Lucilia papuensis Macquart, 1843

Lucilia porphyria (Walker, 1856)

Lucilia sericata (Meigen, 1826)

Lucilia sinensis Aubertin, 1933

Subfamily: Polleniinae

Genus: *Pollenia* Robineau-Desvoidy, 1830

Pollenia dasypoda Portschinsky, 1881

Pollenia pediculata Macquart, 1834

Pollenia rudis (Fabricius, 1794)

Subfamily: Bengaliinae

Genus: *Bengalia* Robineau-Desvoidy, 1830

Bengalia bezzii Senior-White, 1923

Bengalia escheri Bezzi, 1913

Bengalia martinleakei Senior-White, 1930

Bengalia surcoufi Senior-White, 1923

Bengalia torosa (Wiedemann, 1819)

Bengalia unicolor Séguy, 1946

Subfamily: Chrysomyinae

Genus: *Chrysomya* Robineau-Desvoidy, 1830

Chrysomya albiceps (Wiedemann, 1819)

Chrysomya nigripes Aubertin, 1932

Chrysomya phaonis Séguy, 1928

Chrysomya megacephala (Fabricius, 1794)

Chrysomya regalis (Walker, 1858)

Chrysomya pinguis (Walker, 1858)

Chrysomya rufifacies (Macquart, 1843)

Genus: *Phormia* Robineau-Desvoidy, 1830

Phormia regina (Meigen, 1826)

Genus: *Protocalliphora* Hough, 1899

Protocalliphora azurea (Fallén, 1817)

Protocalliphora maruyamensis Kano *et* Shinonaga, 1966

Protocalliphora terraenovae (Robineau-Desvoidy, 1830)

Subfamily: Rhiniinae

Genus: *Rhinia* Robineau-Desvoidy, 1830

**Rhinia apicalis* (Wiedemann, 1830) Figure (A)

An updated checklist of blow fly (Diptera: Calliphoridae) fauna of Pakistan

Material Examined: Kashmir (Pakistan): Hajira, 3200 ft, 1♂, 13.vii.2017; Banjosa, 6000 ft, 1♀, 14.iv.2016, leg. M.A. Hassan.

New Record

Distribution: India, Pakistan, Saudi Arabia, Thailand.



A. *Rhinia apicalis* (Wiedemann, 1830)



B. *Isomyia electa* (Villeneuve, 1927)



C. *Calliphora loewi* Enderlein, 1903



D. *Stomorhina xanthogaster* (Wiedemann, 1820)



E. *Lucilia calviceps* Bezzi, 1927

Genus: *Stomorphina* Rondani, 1861

Stomorphina cribrata (Bigot, 1874)

Stomorphina discolor (Fabricius, 1794)

Stomorphina lunata (Fabricius, 1805)

Stomorphina procula (Walker 1849)

**Stomorphina xanthogaster* (Wiedemann, 1820) Figure (D)

Material Examined: Kashmir (Pakistan): Hajira, 3200 ft, 2♂, 13.vii.2017, leg. M.A. Hassan. **New Record**

Distribution: China, India, Indonesia, Malaysia, Nepal, Pakistan, Sri Lanka.

Genus: *Cosmina* Robineau-Desvoidy, 1830

Cosmina prasina (Brauer et Bergenstamm, 1889)

Genus: *Isomyia* Walker, 1860

Isomyia aurifacies James, 1970

**Isomyia electa* (Villeneuve, 1927) Figure (B)

Material Examined: Kashmir (Pakistan): Rawalakot, 5500 ft, 1♀, 18.v.2016. Gilgit-Baltistan: Skardu, 8000 ft, 1♀, 22.v.2015, leg. M.A. Hassan. **New Record**

Distribution: India, Pakistan, Thailand.

Isomyia fulvicornis (Bigot, 1887)

Isomyia pseudoviridana (Peris, 1952)

Genus: *Rhyncomya* Robineau-Desvoidy, 1830

Rhyncomya townsendi James, 1977

Genus: *Onesia* Robineau-Desvoidy, 1830

Onesia kiyoshii Kurahashi, 2002

Acknowledgements

We wish to express our sincere thanks to Mr. Anjum Shehzad of National Insect Museum, Pakistan for laboratory facilities and for the images.

References

Akbarzadeh, K., Wallman, J.F., Sulakova, H. and Szpila, K. 2015. Species identification of Middle Eastern blowflies (Diptera: Calliphoridae) of forensic importance. *Parasitology Research* 114:1463–1472.

Bharti, M. and Kurahashi, H. 2010. *Lucilia calviceps* Bezzi, new record from India (Diptera: Calliphoridae), with a revised key to Indian species. *Halteres* 1 (2): 29-30.

Bharti, M. 2011. An update checklist of blowflies (Diptera: Calliphoridae) from India. *Halteres* 3: 34-37.

Bharti, M. 2012. Altitudinal Diversity of Forensically Important Blowflies Collected from Decaying Carcasses in Himalaya. *The Open Forensic Science Journal* 5: 1-3.

Bharti, M. 2014a. The first record of *Chrysomya chani* Kurahashi, 1979 (Diptera: Calliphoridae) from India, with a key to the known Indian species. *Caucasian Entomological Bulletin* 10(2): 305-306.

Bharti, M. 2014b. New Record of *Stomorphina siamensis* Kurahashi Et Tumrasvin, 1992 from India, with revised key to Indian species of the Genus *Stomorphina* (Diptera: Calliphoridae). *Far Eastern Entomologist* 281: 7-11.

Bharti, M. 2015. *Polleniopsis annamensis* Kurahashi, 1972 (Diptera: Calliphoridae) a new record from India, with a revised key to the known Indian species. *Halteres* 6: 63-65.

Bharti, M. 2016. *Melinda pusilla pusilla* (Villeneuve, 1927) (Diptera: Calliphoridae), a new record from India with a revised key to the known Indian species. *Halteres* 7: 43-45.

Bharti, M. and Bunchu, N. 2016. Three New Records of the Genus *Isomyia* (Walker, 1859) (Diptera: Calliphoridae) from India, with a Revised Key to the Known Indian Species. *Japanese Journal of Systematic Entomology* 22 (2): 241–244.

Bharti, M. and Verves, Y. 2016. A new species of genus *Polleniopsis* from India (Diptera: Calliphoridae) with a key to the Indian species. *Halteres* 7: 1-4.

Dag, A. and Gazit, S. 2001. Mango pollinators in Israel. *Journal of Applied Horticulture* 2: 39-43.

Kosmann, C., de Mello, R.P., Souza, E.S.H. and Luz, J.R.P. 2013. A List of Current Valid Blow Fly Names (Diptera: Calliphoridae) in the Americas South of Mexico with Key to the Brazilian Species. *Entomo Brasilis* 6 (1): 74-85.

Kurahashi, H. and Afzal, M. 2002. The blow flies recorded from Pakistan, with the description of one new species (Diptera: Calliphoridae). *Medical Entomology and Zoology* 53(2): 213-230.

An updated checklist of blow fly (Diptera: Calliphoridae) fauna of Pakistan

- Kurahashi, H. and Bunchu, N. 2011. The Blow flies recorded from Thailand, with the Description of a New Species of *Isomyia* WALKER (Diptera, Calliphoridae) Japanese Journal of Sanitary Zoology 17(2): 237-278.
- Nandi, B.C. 2000. Studies on blowflies (Diptera: Calliphoridae) of Sikkim, India. Records of Zoological Survey of India 98 (4): 1-9.
- Nandi, B.C. 2002. Blow flies (Diptera: Calliphoridae) of West Bengal, India with a note on their Biodiversity. Records of Zoological Survey of India 100 (1-2): 117-129.
- Senior-White, R., Aubertin, D. and Smart, J. 1940. The fauna of British India, including remainder of the Oriental region. Diptera VI. Family Calliphoridae. London: Taylor and Francis.
- Setyaningrum, H. and Al Dhafer, H.M. 2014. The Calliphoridae the blow flies (Diptera: Oestroidea) of Kingdom of Saudi Arabia. Egyptian Academic Journal of Biological Sciences 7(1): 49-139.
- Tomberlin, J.K. and Benbow, M.E. (Eds). 2015. Forensic Entomology: International Dimensions and Frontiers. Boca Raton, FL: CRC Press, pp. 443.
- Yang, S.T., Kurahashi, H. and Shiao, S.F. 2014. Keys to the blow flies of Taiwan, with a checklist of recorded species and the description of a new species of *Paradichosia* Senior-White (Diptera, Calliphoridae). ZooKeys 434: 57–109.

***Pellenes iva* sp. n. (Araneae: Salticidae) with a distinct M-shaped central epigynal pocket from India**

John T.D. Caleb and Vikas Kumar*

Centre for DNA Taxonomy, Zoological Survey of India, Prani Vigyan Bhawan, M-Block, New Alipore, Kolkata-700 053, West Bengal, India.

(Email: vikaszsi77@gmail.com)

Abstract

A new species of the jumping spider genus *Pellenes* Simon 1876, *Pellenes iva* sp. n. is described from Chennai, India. Both sexes of the species are diagnosed and illustrated in detail.

Keywords: *diagnosis, taxonomy, new species, jumping spider, Chennai.*

Received: 28 August 2017; Revised: 12 April 2018; Online: 16 April 2018.

Introduction

The jumping spider genus *Pellenes* was erected by Simon in 1876 with *Pellenes tripunctatus* (Walckenaer, 1802) as the type species. Currently, 82 valid species are known from Asia, Africa, Europe, North America and Australia (World Spider Catalog, 2017). Out of these, two species are known from India; *P. allegrii* Caporiacco, 1935 from Kashmir and *P. maderianus* Kulczyński, 1905 from Jabalpur, Madhya Pradesh (Caporiacco, 1935; Prószyński, 1992). In the present paper, we describe a third species, *Pellenes iva* sp. n. from southern part of India.

Materials and Methods

Live specimens were photographed using Nikon D3200. The specimens were preserved in 70% ethanol and examined using a Leica EZ4 HD and Leica M205A stereoscopic microscope. Micro-photographs were obtained using Leica DFC500 HD digital camera attached to stereoscopic microscope with LAS core software package. All measurements are in millimeters. Leg measurements are given as: total length (femur, patella, tibia, metatarsus, tarsus). Descriptions are based on fresh specimens. Spine positions are as follows: prolateral, dorsal, retrolateral and ventral. Terminology used for copulatory organs follow Logunov *et al.* (1999). The types have been

deposited in the National Zoological Collections, Centre for DNA taxonomy, Zoological Survey of India, Kolkata (ZSI-CDT) and Zoological Survey of India, Southern Regional Centre, Chennai (ZSI-SRC).

Abbreviations used in the text: ALE – anterior lateral eye, AME – anterior median eye, AER – anterior eye row, CBP – central blind-ending pocket, CTA – compound terminal apophysis, EFL – eye field length, PER – posterior eye row, PLE – posterior lateral eye, PME – posterior median eye, RTA – retrolateral tibial apophysis, ZSI-CDT – Zoological Survey of India, Centre for DNA Taxonomy, Kolkata, ZSI-SRC – Zoological Survey of India, Southern Regional Centre, Chennai.

Taxonomy

***Pellenes* Simon, 1876**

Type species: *Pellenes tripunctatus* (Walckenaer, 1802)

Diagnosis: For diagnostic features and description, see Logunov *et al.* (1999).

***Pellenes (Pelmultus) iva* Caleb sp. n.**
(Iva's jumping spider)
(Figs. 1–29)

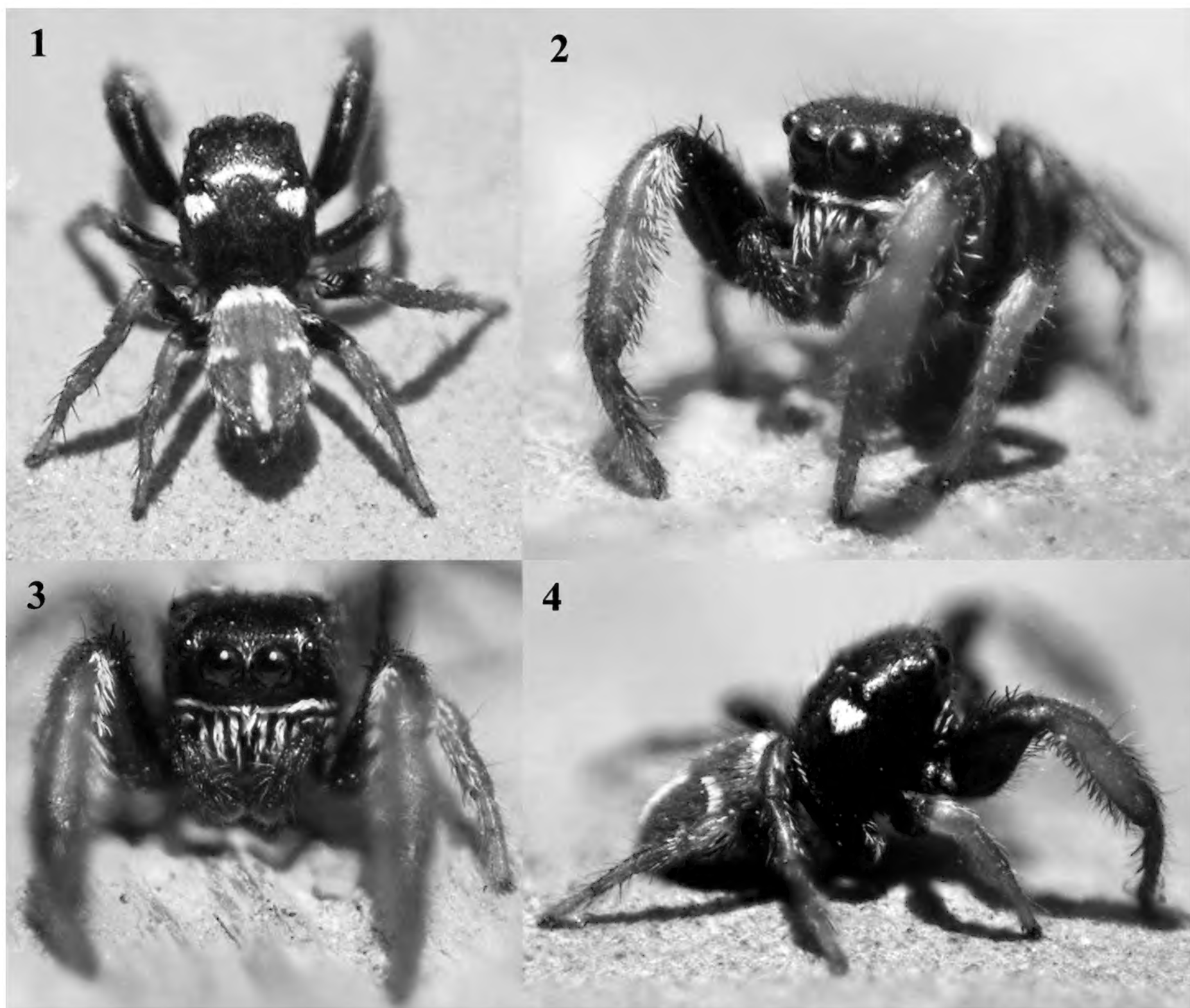
[urn:lsid:zoobank.org:act:0002EE60-B41D-44F0-AF35-167B66FB5214](https://zoobank.org/urn:lsid:zoobank.org:act:0002EE60-B41D-44F0-AF35-167B66FB5214)

Type material: Holotype: Male (ZSI-SRC-I/SP 34) India: Tamil Nadu, Thirumullaivoyal (13.1251° N, 80.1355° E, 24 m), 16 August 2015, leg. John Caleb T.D. **Paratypes:** 2 males (ZSI-SRC-I/SP 35) and (ZSI-CDT-AA1065) from same location, 22 June 2016; and 1 female (ZSI-CDT-AA1064) India: Tamil Nadu, Thiruninravur (13.1232° N, 80.0447° E, 32 m) 29 June 2016, leg. John Caleb T.D.

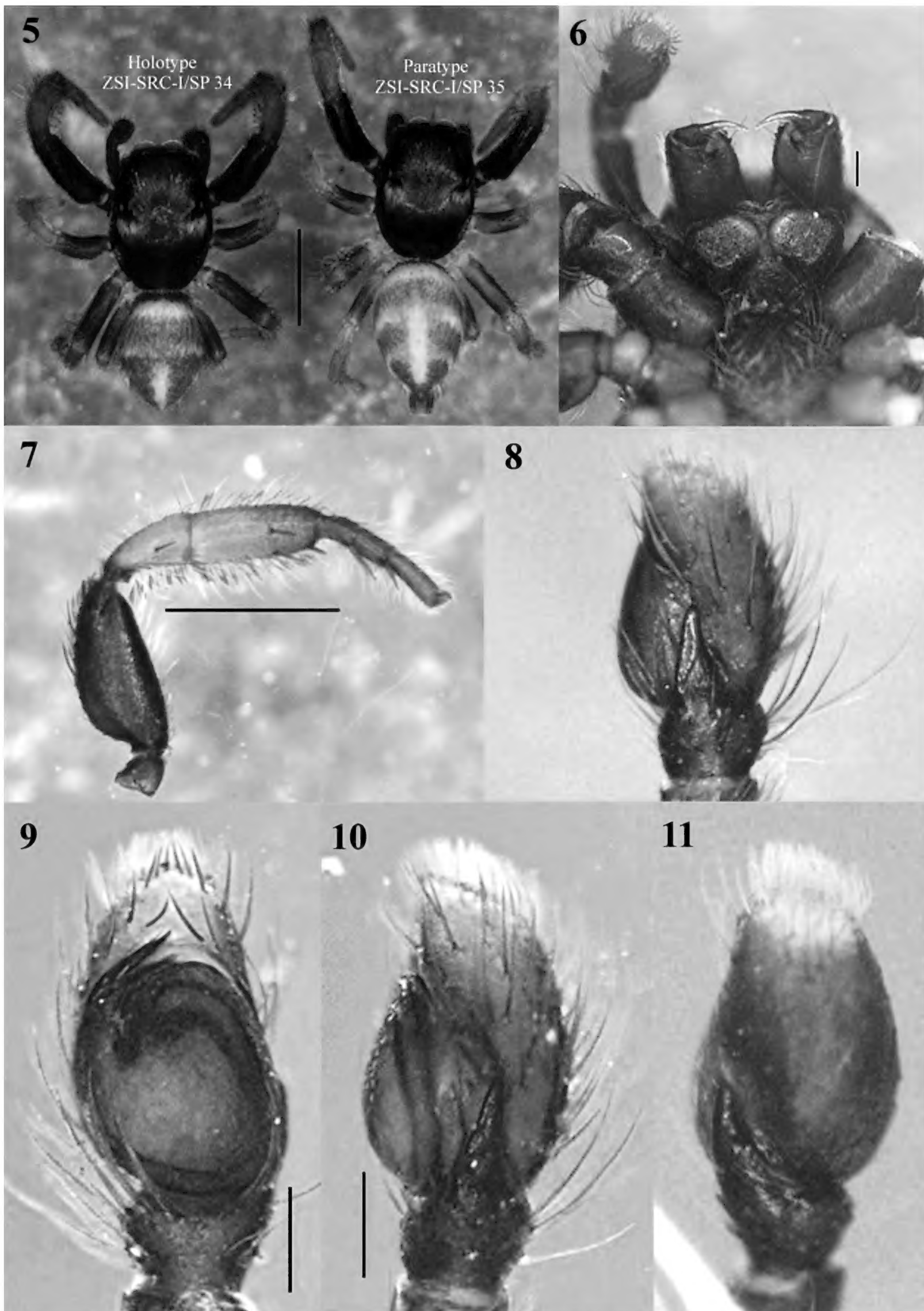
Etymology: The specific name is a noun in

apposition, named for the first author's daughter 'Esther Iva'.

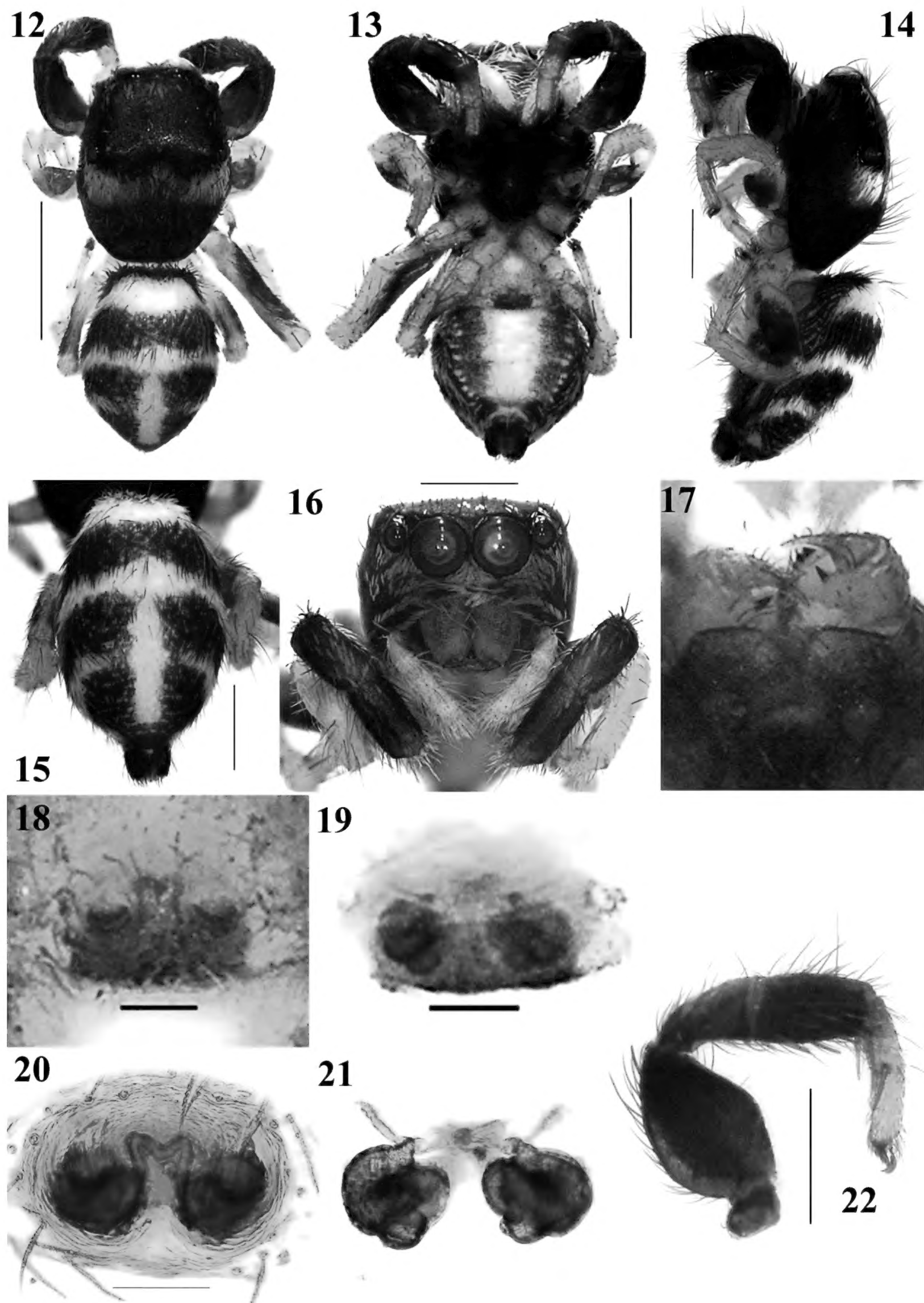
Diagnosis: The species closely resembles *Pellenes bitaeniata* (Keyserling, 1882) in general color pattern (cf. Figs. 1–5, 12 with Figs. 1–4 in Zabka, 2006) but differs by the shape of CTA (elongated terminally in *P. bitaeniata*); presence of a small, thick ridge on the cymbium near the RTA (indicated by arrows in Figs. 26, 27). Female can be readily distinguished by the characteristic M-shaped CBP (arched in *P. bitaeniata* and majority of *Pellenes* species) (Figs. 18, 20, 28).



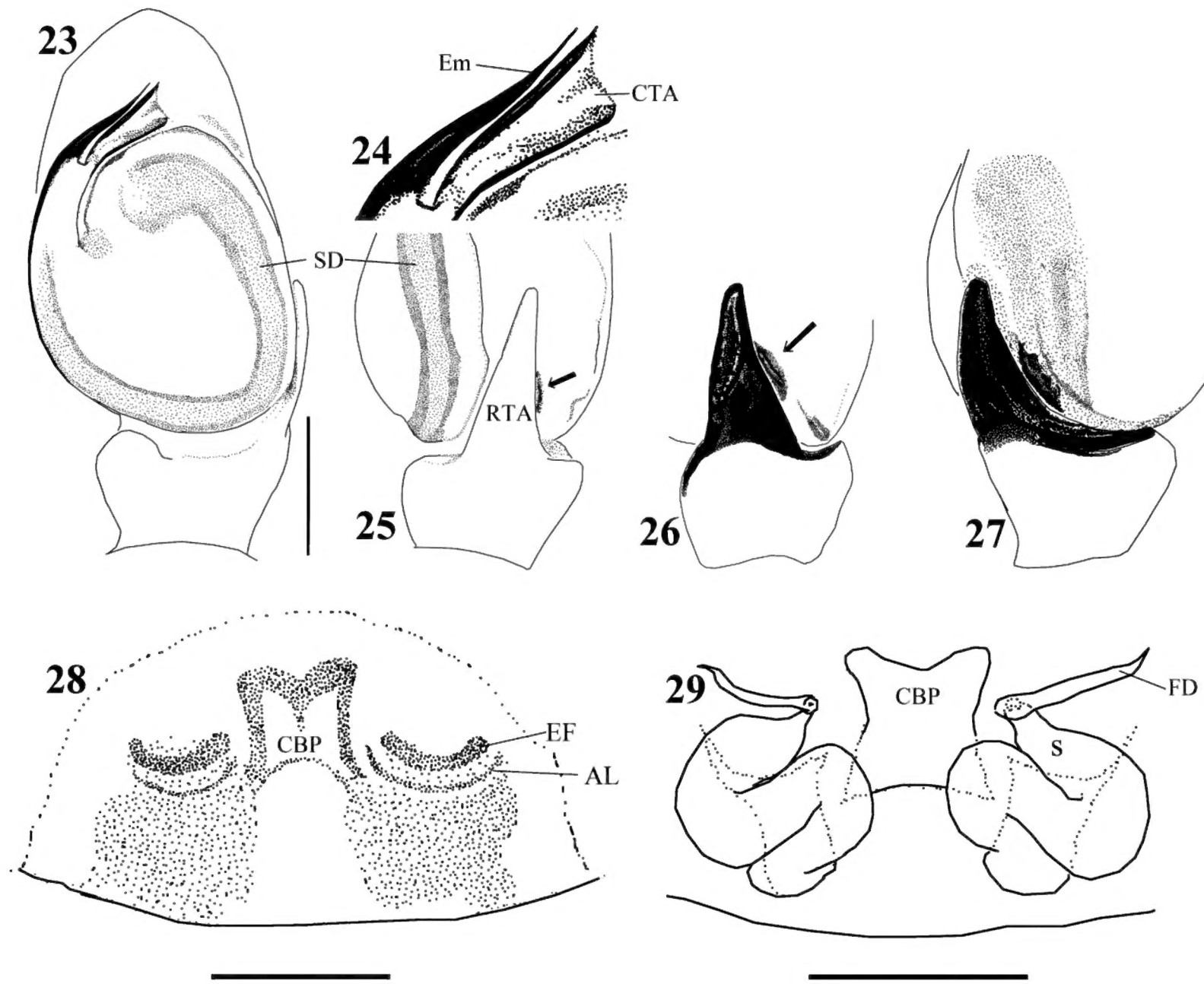
Figures 1–4. *Pellenes iva* sp. n. holotype male (ZSI-SRC-I/SP 34): 1. Dorsal view; 2. fronto-lateral view; 3. frontal view; 4. lateral view.



Figures 5–11. *Pellenes iva* sp. n. holotype male: 5. Dorsal view; 6. chelicerae, maxillae and labium; 7. leg I, prolateral view; 8. left palp, retrolateral view; 9. same, ventral view; 10. same, retrolateral view; 11. same, dorso-lateral view. Scale bars: 1 mm (5, 7); 0.1 mm (6, 9–10).



Figures 12–22. *Pellenes iva* sp. n. paratype female (ZSI-CDT-AA 1064): 12. dorsal view; 13. ventral view; 14. lateral view; 15. abdomen, dorsal view; 16. front view; 17. chelicerae; 18. epigyne, ventral view; 19. vulva, dorsal view; 20. epigyne, ventral view; 21. vulva, dorsal view; 22. leg I, prolateral view. Scale bars: 1 mm (12–13); 0.5mm (14–16, 22); 0.1 mm (18–20).



Figures 23–29. *Pellenes iva* sp. n.: 23. left male palp, ventral view; 24. embolic division; 25. left palp, retrolateral view; 26. tibial apophysis, retrolateral view; 27. same, dorso-lateral view; 28. epigyne, ventral view; 29. vulva, dorsal view. Abbreviations: AL – atrial lip; CBP – central blind-ending pocket; CTA – compound terminal apophysis; EF – epigynal fold; Em – embolus; FD – fertilization duct; RTA – retrolateral tibial apophysis; S – spermathecae; SD – sperm duct. Scale bars: 0.1mm (23, 28–29).

Description: Male holotype (Figs. 1–11, 23–27). Total length: 2.82; carapace: 1.48 long, 1.17 wide, 0.71 high at PLE; abdomen: 1.43 long, 0.95 wide. Carapace black, covered with pale hairs; a pair of white spots found behind the PLEs made of scale like hairs (Figs. 1, 4). Clypeal region blackish; anterior margin of clypeus lined by white scales which extend to the lateral sides; eyes surrounded by white orbital setae (Fig. 3). Eye measurements: AME 0.29, ALE 0.14, PME 0.03, PLE 0.13, AER 0.88, PER 1.04, EFL 0.58. Clypeus height 0.14. Chelicerae length 0.47. Chelicerae dark brown with vertical stripes of white scales (Fig. 3); two fused teeth on the promargin and one tooth on the retromargin (Fig. 6). Sternum oval, brownish; labium and maxillae dark brown. Leg

I robust (Fig. 5); femora I–IV dark brown, other segments yellowish. Legs clothed with white leaf-like scales on the lateral margins of patella and tibia (Figs. 2, 4, 7). Leg measurements: I 3.24 (1.04, 0.66, 0.75, 0.45, 0.34); II 2.03 (0.65, 0.43, 0.35, 0.32, 0.28); III 2.99 (1.06, 0.53, 0.58, 0.46, 0.36); IV 2.38 (0.78, 0.40, 0.43, 0.42, 0.35). Leg formula: 1342. Spination. Legs: femora I 0500, II 0300, III 0300, IV 0100; patellae I–II 1000, III 1010, IV 1000; tibiae I 1003, II 1002, III 2022, IV 2012; metatarsi I 0004, II 1003, III 3043, IV 1022; tarsi I–IV 0000. Abdomen ovoid, densely covered with rusty brown hairs; anterior margin covered by white scales; a longitudinal mid-dorsal stripe begins from the center and extends to the posterior end; two pairs of lateral white patches

seen converging (Figs. 1, 5). Spinnerets brownish (Fig. 5). Palps dark brown; embolus thin accompanied by a CTA; RTA stout and strong with a blunt tip; a small ridge present hidden behind the RTA (Figs. 9–11, 23–27).

Female: (ZSI-CDT-AA1064) (Figs. 12–22, 28–29) Total length 2.93, carapace: 1.42 long, 1.14 wide, 0.68 high at PLE; abdomen: 1.51 long, 1.02 wide. Eye measurements: AME 0.31, ALE 0.14, PME 0.04, PLE 0.14. AER 0.91, PER 1.06, EFL 0.59. Clypeus height 0.10. Chelicerae length 0.33. Leg measurements: I 2.16 (0.68, 0.45, 0.42, 0.32, 0.29); II 1.73 (0.53, 0.38, 0.32, 0.28, 0.22); III 2.71 (0.97, 0.50, 0.49, 0.41, 0.34); IV 2.21 (0.72, 0.37, 0.41, 0.40, 0.31). Leg formula: 3412. Leg spination: femora I 0200; II 0200, III 0300, IV 0000; patellae I 0000, II 1000, III 1010, IV 1000; tibiae I 0004, II 1002, III 2022, IV 2001; metatarsi I 0004, II 0004, III 3033, IV 2022. Coloration pattern as in male but differs in the following: eye field covered with sparse white scales; some white scales are also present between the posterior pair of white spots (Fig. 12). Clypeus covered with white scales; chelicerae covered with pale hairs (Fig. 16). Pedipalps yellowish. Leg I with dark brown patella and tibia (Fig. 22). Epigyne with a pair of curved, lateral copulatory openings; CBP with a median invagination with characteristic M-shaped appearance (Figs. 18, 20, 28); internal structures shown in Figs. 19, 21 & 29.

Natural history: The species was found in the grassy patches along with mixed shrubs in the neighborhood nearby Araabath lake.

Distribution: India (Tamil Nadu: Chennai).

Remarks: Two species of the genus *Pellenes* are known from India: *P. allegrii* Caporiacco, 1935 from Kashmir and *P. maderianus* Kulczyński, 1905 from Jabalpur, Madhya Pradesh. Logunov *et al.* (1999) while reviewing the genus remarked that the Indian specimen which was known by a single female, identified by Prószyński (1992) as *P. maderianus* actually belongs to another species. It is likely that the species identified as *P. maderianus* from India

could probably represent the new species described herein.

Acknowledgements

The authors are grateful to Dr Kailash Chandra, Director, Zoological Survey of India for his encouragement and moral support and providing necessary facilities to carry out the work. John Caleb acknowledges the American Arachnological Society for an Arachnological research grant from the Herbert Levi fund (HLMFAR). Sincere thanks go to Dr. Himender Bharti for providing constructive comments on the manuscript which greatly improved it.

References

- Caporiacco, L. di. 1935. Aracnidi dell'Himalaia e del Karakoram, raccolti dalla Missione italiana al Karakoram (1929-VII). Memorie della Società Entomologica Italiana, Genova 13: 161–263.
- Keyserling, E. 1882. Die Arachniden Australiens. Nürnberg 1: 1325–1420.
- Kulczyński, W. 1905. Araneae nonnullae in insulus Maderianis collectae a Rev. E. Schmitz. Bulletin International de l'Academie des Sciences de Cracovie 1905: 440–460.
- Logunov, D. V., Marusik, Y. M. and Rakov, S. Y. 1999. A review of the genus *Pellenes* in the fauna of Central Asia and the Caucasus (Araneae, Salticidae). Journal of Natural History 33(1): 89–148. doi:10.1080/002229399300489.
- Prószyński, J. 1992. Salticidae (Araneae) of India in the collection of the Hungarian National Natural History Museum in Budapest. Annales Zoologici, Warszawa 44: 165–277.
- World Spider Catalog. 2017. World Spider Catalog (version 18.5). Natural History Museum Bern. <http://wsc.nmbe.ch> [accessed on 02 August 2017].
- Žabka, M. 2006. Salticidae (Arachnida: Araneae) from Oriental, Australian and Pacific regions. XIX. Genus *Pellenes* Simon, 1876 in Australia. Annales Zoologici, Warszawa 56: 567–573.

Fauna of Sarcophagidae and Calliphoridae (Diptera) of the West Ukraine

¹Yuriy Verves* and ²Lyudmyla Khrokalo

¹*Department of Ecological Monitoring, Institute for Evolutionary Ecology, National Academy of Sciences of Ukraine, Kyiv, Ukraine, Academician Lebedev Str. 37, Kyiv, Ukraine, 03143.*

²*Department of Physical Chemistry, National Technical University of Ukraine “Kyiv Polytechnic Institute”, Peremohy Ave. 37, Kyiv, Ukraine, 03056.*

(Email: yuryverves@gmail.com)

Abstract

A total of 74 calliphorid and 180 sarcophagid species are listed from Ukraine, however in the present paper 48 calliphorid and 101 sarcophagid species, which are known from West Ukrainian territory are listed. One calliphorid species (*Eggisops pecchiolii*) is firstly recorded for territory of Ukraine. 16 species are firstly reported from Lviv region, including 10 species of Sarcophagidae (*Nyctia halterata*, *Blaesoxipha laticornis*, *Heteronychia bulgarica*, *H. haemorrhoea*, *H. rohdendorffiana*, *Bellieriomima subulata*, *Liopygia argyrostoma*, *Kramerea schuetzei*, *Rosellea aratrix*, *Sarcophaga schusteri*) and 6 species of Calliphoridae (*Lucilia silvarum*, *L. ampullacea*, *L. illustris*, *Pollenia hungarica*, *P. labialis*, *P. vera*). 7 species of Calliphoridae (*Lucilia illustris*, *Protocalliphora azurea*, *P. proxima*, *P. rognesi*, *Trypocalliphora braueri*, *Eggisops pecchiolii*, *Pollenia vera*) and 6 species of Sarcophagidae (*Pterella melanura*, *Miltogramma brevipila*, *Metopia argentata*, *M. italiana*, *Amobia signata*, *Blaesoxipha grylloctona*) are firstly recorded from Zakarpattia region. One species of Sarcophagidae (*Sarcophaga jupalnica*) is firstly reported for Ivano-Frankivsk region.

Keywords: *Calliphoridae, Sarcophagidae, fauna, West Ukraine.*

Received: 01 November 2017; Revised: 28 May 2018; Online: 30 May 2018.

Introduction

Altogether (including present data) 74 species of Calliphoridae (Grunin, 1970; Szpila & Verves, 2008; Verves, 1985b, 2003, 2004, 2005, 2012, 2013; Verves & Khrokalo, 2010) and 180 species of Sarcophagidae (Draber-Mońko, 1973; Khitzova, 1976; Povolný & Verves, 1986, 1997; Rohdendorf, 1970; Verves, 1973, 1974, 1975, 1978a, b, 1982, 1984, 1985a, 1986, 1989, 1993, 1998, 2000, 2003, 2014; Verves & Khrokalo, 2010, 2014a, b; Verves & Radchenko, 2017; Verves & Szpila, 2008, 2011; Verves *et al.*, 1977, 1989, 1984, 1991) have been recorded from the Ukraine.

Materials and Methods

The faunistic data of the results of field collections of both authors in West Ukraine, Zakarpattia (Uzhgorod District, Nyzhne Solotvyno village, 48°33'N, 22°26'E, 140-200 m.a.s.l. 16-23.viii. 2014 and 08-21.viii. 2015 in

beech forest; Irshava District, Dovhe village, 48°22' N, 23°17'E, 160-220 m.a.s.l., 08-26.viii.2016, at mesophytic meadows with bushes) and Lviv (north environs of Truskavets City, 49°17' N, 23°31' E, 330-350 m.a.s.l., 2-18.viii.2017 in bushes and beech forest along stream) regions (= “oblasts”) are presented (Table 1). Flies were collected by net. The genera and subgenera of Sarcophagidae are given after Verves, 1986, 1989, 1990, 1993; Verves & Khrokalo, 2006; Calliphoridae – after Rognes, 1991, 1998; Rognes & Pape, 2007. The analysis and generalization of literature data about regional faunas of West Ukraine are presented too. Several investigations of regional faunas have been realized in borders of West Ukraine (Verves, 1979a, b) and its separate regions: Chernivtsi (Verves, 1985b, 2001), Ivano-Frankivsk (Verves, 1977), and Volyn (Khrokalo & Verves, 2009) regions. A level of

knowledge of faunas of both families of West Ukraine is moderately low (see Table 2).

Results

1305 specimens from 64 species were collected and identified (Table 1). 16 species are firstly reported from Lviv region, including 10 species of Sarcophagidae (*Nyctia halterata*, *Blaesoxipha laticornis*, *Heteronychia bulgarica*, *H. haemorrhoea*, *H. rohdendorffiana*, *Bellieriomima subulata*, *Liopygia argyrostoma*, *Kramerea schuetzei*, *Rosellea aratrix*, *Sarcophaga schusteri*) and 6 species of Calliphoridae (*Lucilia silvarum*, *L. ampullacea*, *L. illustris*, *Pollenia hungarica*, *P. labialis*, *P. vera*). 7 species of Calliphoridae (*Lucilia illustris*, *Protocalliphora azurea*, *P. proxima*, *P. rognesi*, *Trypocalliphora braueri*, *Eggisops pecchiolii*, *Pollenia vera*) and 6 species of Sarcophagidae (*Pterella melanura*, *Miltogramma brevipila*, *Metopia argentata*, *M. italiana*, *Amobia signata*, *Blaesoxipha grylloctona*) are firstly recorded from Zakarpattia region. One species of Sarcophagidae (*Sarcophaga jupalnica*) is firstly reported for Ivano-Frankivsk region. One species, *Eggisops pecchiolii*, is firstly reported from Ukraine. As a result, the quantity of Ukrainian species of Calliphoridae grew to 74 correspondently. The lists of recorded regional species are essentially widened: for Lviv region - Sarcophagidae (from 30 to 41) and Calliphoridae (from 9 to 15); for Zakarpattia region - Sarcophagidae (from 73 to 79) and Calliphoridae (from 28 to 34). One species of sarcophagids is firstly found in Ivano-Frankivsk region (its number of species grew to 62).

The check lists of species of Calliphoridae and species of Sarcophagidae from different regions of West Ukraine according to analysis of literature data and original collections of authors are given below.

Calliphoridae

1. *Bellardia bayeri* (Jacentkovský, 1937). "East Carpathians" (Grunin, 1970); Chernivtsi region (Verves, 2005; Verves & Khrokalo, 2010); Vyzhnytsia district, Dolyshny Shepit village (Verves, 2001); Ivano-Frankivsk region (Grunin, 1970; Schumann, 1974; Verves & Khrokalo, 2010); Lviv region (Schumann, 1974; Verves & Khrokalo, 2010), Zakarpattia region (Schumann, 1974; Verves &

Khrokalo, 2010); Mezigiria district, Kolochava village (Verves, 2005).

2. *B. pandia* (Walker, 1849). Chernivtsi region (Skufyin & Khitzova, 1978; Verves & Khrokalo, 2010), Vyzhnytsia district, Lopushna village (Skufyin & Khitzova, 1978); Khmelnytskyi region (Grunin, 1970; Verves & Khrokalo, 2010); Volyn region: Shatsk district, environs of Svitiaz lake (Khrokalo & Verves, 2009); Zakarpattia (Grunin, 1970; Verves & Khrokalo, 2010).

3. *B. polita* (Mik, 1884). Zakarpattia: environs of Mukacheve city (Verves, 1985b).

4. *B. stricta* (Villeneuve, 1926). Chernivtsi region (Skufyin & Khitzova, 1978; Verves & Khrokalo, 2010): Khotyn town (Verves, 1985); Novoselitzia district, Chernivka village (Skufyin & Khitzova, 1978); Vyzhnytsia district, Dolyshny Shepit village (Verves, 2001); Lopushna village (Skufyin & Khitzova, 1978); Khmelnytskyi region (Grunin, 1970; Verves & Khrokalo, 2010); Volyn region (Verves & Khrokalo, 2010): Shatsk district, environs of Svitiaz lake (Khrokalo & Verves, 2009); Zakarpattia region (Verves & Khrokalo, 2010); Mezigiria district, Kolochava village (Verves, 2005); Mukacheve city (Verves, 2005).

5. *B. viarum* (Robineau-Desvoidy, 1830). Chernivtsi region (Verves & Khrokalo, 2010): Vyzhnytsia district, Dolyshny Shepit village (Verves, 2001).

6. *B. vulgaris* (Robineau-Desvoidy, 1830). "East Carpathians" (Grunin, 1970); Chernivtsi region: Novoselitzia district, Chernivka village (Skufyin & Khitzova, 1978); Vyzhnytsia district, Dolyshny Shepit village (Verves, 2001); Lopushna village (Skufyin & Khitzova, 1978).

7. *Calliphora* (s. str.) *loewi* Enderlein, 1903. Chernivtsi region (Verves, 2005; Verves & Khrokalo, 2010): Vyzhnytsia district, Dolyshny Shepit village (Verves, 2001); Volyn region (Verves & Khrokalo, 2010): Shatsk district, environs of Svitiaz lake (Khrokalo & Verves, 2009); Zakarpattia region: Mezigiria district, Kolochava village (Verves & Khrokalo, 2010).

8. *C.* (s. str.) *uralensis* Villeneuve, 1922. Chernivtsi region (Verves, 2005; Verves & Khrokalo, 2010): environs of Khotyn town (Verves, 1985b); Novoselitzia district, Chernivka village (Skufyin & Khitzova, 1978); Putila district, Shepit village (Skufyin & Khitzova, 1978); Vyzhnytsia district, Dolyshny Shepit village (Verves, 2001); Lopushna village (Skufyin & Khitzova, 1978); Volyn region

(Verves, 2005; Verves & Khrokalo, 2010): Lutzk (Khanina & Khvesik, 1963); Shatsk district, environs of Svitiaz lake (Khrokalo & Verves, 2009); Zakarpattia region (Verves, 2005; Verves & Khrokalo, 2010): Mukacheve district, Siniak village (Skufyin & Khitzova, 1978); Uzhhorod (Moskaletz, 1960).

9. *C. (s. str.) vicina* Robineau-Desvoidy, 1830. Chernivtsi region (Verves, 2005; Verves & Khrokalo, 2010): environs of Khotyn town (Verves, 1985b); Novoselitzia district, Chernivka village (Skufyin & Khitzova, 1978); Putila district, Shepit village (Skufyin & Khitzova, 1978); Vyzhnytsia district, Dolyshny Shepit village (Verves, 2001); Zaleshchyky town (Verves, 2005); Khmelnytskyi region (Verves & Khrokalo, 2010; Viktorov-Nabokov, 1959); Lviv region (Verves & Khrokalo, 2010); Ternopil region (Verves & Khrokalo, 2010; Viktorov-Nabokov, 1959); Volyn region (Verves, 2005; Verves & Khrokalo, 2010): Lutzk (Khanina & Khvesik, 1963); Shatsk district, environs of Svitiaz lake (Khrokalo & Verves, 2009); Zakarpattia region: Mezigiria district, Kolochava village (Verves & Khrokalo, 2010); Uzhhorod (Moskaletz, 1960).

10. *C. (s. str.) vomitoria* (Linnaeus, 1758). Chernivtsi region (Verves, 2005; Verves & Khrokalo, 2010): environs of Khotyn town (Verves, 1985b); Putila district, Shepit village (Skufyin & Khitzova, 1978); Vyzhnytsia district, Dolyshny Shepit village (Verves, 2001); Lopushna village (Skufyin & Khitzova, 1978); Ivano-Frankivsk region: Rozhnyativ district, Mshana river valley (Verves & Khrokalo, 2010); Khmelnytskyi region (Belke, 1859); Lviv region (Verves & Khrokalo, 2010); Zhidachiv town (Verves, 2005); Volyn region (Verves & Khrokalo, 2010): Shatsk district, environs of Svitiaz lake (Khrokalo & Verves, 2009); Zakarpattia region: Mezigiria district, Kolochava village (Verves & Khrokalo, 2010); Mukacheve district, Siniak village (Skufyin & Khitzova, 1978); Uzhhorod (Moskaletz, 1960).

11. *C. (Steringomyia) stelviana* (Brauer & Bergenstamm, 1891). Chernivtsi region (Verves, 2005): Vyzhnytsia district, Dolyshny Shepit village (Verves, 2001).

12. *C. (S.) subalpina* (Ringdahl, 1931). Chernivtsi region (Verves, 2005): Vyzhnytsia district, Dolyshny Shepit village (Verves, 2001); Volyn region (Verves & Khrokalo, 2010): Shatsk district, environs of Svitiaz lake (Khrokalo & Verves, 2009).

13. *Cynomya mortuorum* (Linnaeus, 1761). Chernivtsi region (Verves, 2005; Verves & Khrokalo, 2010): Khotyn town (Verves, 1985); Putila district,

Shepit village (Skufyin & Khitzova, 1978); Vyzhnytsia district, Dolyshny Shepit village (Verves, 2001); Ivano-Frankivsk region: Rozhnyativ district, Mshana river valley (Verves & Khrokalo, 2010); Volyn region (Verves & Khrokalo, 2010).

14. *Onesia austriaca* Villeneuve, 1920. “East Carpathians” (Grunin, 1970); Chernivtsi region: Novoselitzia district, Chernivka village (Skufyin & Khitzova, 1978); Putila district, Shepit village (Skufyin & Khitzova, 1978); Vyzhnytsia district, Dolyshny Shepit village (Verves, 2001); Lopushna village (Skufyin & Khitzova, 1978); Ivano-Frankivsk region: Kosiv district, Gorod village (Verves, 1985b, 2005); Zakarpattia region: Mezigiria district, Kolochava village (Verves, 2005); Mukacheve district, Siniak village (Skufyin & Khitzova, 1978).

15. *O. kowarzi* Villeneuve, 1920. Zakarpattia region: Mukacheve district, Siniak village (Skufyin & Khitzova, 1978).

16. *Lucilia (Bufolucilia) bufonivora* Moniez, 1876. Ternopil region (Verves & Khrokalo, 2010).

17. *L. (B.) silvarum* (Meigen, 1826). Chernivtsi region (Verves, 2005; Verves & Khrokalo, 2010): Khotyn town (Verves, 1985b); Putila district, Shepit village (Skufyin & Khitzova, 1978); Vyzhnytsia district, Dolyshny Shepit village (Verves, 2001); Ivano-Frankivsk region: Rozhnyativ district, Mshana river valley (Verves & Khrokalo, 2010); Volyn region (Verves & Khrokalo, 2010): Shatsk district, environs of Svitiaz lake (Khrokalo & Verves, 2009); Zakarpattia region (Verves, 2005; Verves & Khrokalo, 2010): Uzhhorod (Moskaletz, 1960).

18. *L. (s. str.) ampullacea* Villeneuve, 1922. Zakarpattia region (Verves & Khrokalo, 2010): Mezigiria district, Kolochava village (Verves, 2005).

19. *L. (s. str.) caesar* (Linnaeus, 1758). Chernivtsi region (Skufyin & Khitzova, 1978; Verves & Khrokalo, 2010): environs of Khotyn town (Verves, 1985b); Novoselitzia district, Chernivka village (Skufyin & Khitzova, 1978); Zaleshchyky town (Verves, 2005); Vyzhnytsia district, Dolyshny Shepit village (Verves, 2001); Lopushna village (Skufyin & Khitzova, 1978); Khmelnytskyi region (Belke, 1859; Verves, 2005; Verves & Khrokalo, 2010; Viktorov-Nabokov, 1959); Lviv region (Verves, 2005; Verves & Khrokalo, 2010; Viktorov-Nabokov, 1959); Ternopil region (Verves, 2005; Verves & Khrokalo, 2010; Viktorov-Nabokov, 1959); Volyn region (Verves, 2005; Verves & Khrokalo, 2010): Lutzk (Khanina & Khvesik, 1963); Shatsk district, environs of Svitiaz lake (Khrokalo & Verves, 2009);

Zakarpattia region (Verves, 2005; Verves & Khrokalo, 2010); Uzhhorod (Moskaletz, 1960).

20. *L. (s. str.) illustris* (Meigen, 1826). Chernivtsi region (Verves, 2005; Verves & Khrokalo, 2010): environs of Khotyn town (Verves, 1985b); Vyzhnytsia district, Dolyshny Shepit village (Verves, 2001); Khmelnytskyi region (Belke, 1859); Volyn region (Verves, 2005; Verves & Khrokalo, 2010): Lutzk (Khanina & Khvesik, 1963); Shatsk district, environs of Svitiaz lake (Khrokalo & Verves, 2009); Zakarpattia region: Mezighiria district, Kolochava village (Verves & Khrokalo, 2010).

21. *L. (s. str.) magnicornis* (Siebke, 1863). Khmelnytskyi region (Belke, 1859).

22. *L. (Phaenicia) regalis* (Meigen, 1826). Firstly recorded for West Ukraine.

23. *L. (P.) richardsi* Collin, 1926. Chernivtsi region (Verves, 2005; Verves & Khrokalo, 2010): environs of Khotyn town (Verves, 1985b).

24. *L. (P.) sericata* (Meigen, 1826). Chernivtsi region (Skufyin & Khitzova, 1978; Verves & Khrokalo, 2010): environs of Khotyn town (Verves, 1985b); Khmelnytskyi region (Viktorov-Nabokov, 1959; Verves & Khrokalo, 2010); Lviv region (Viktorov-Nabokov, 1959; Verves & Khrokalo, 2010); Ternopil region (Viktorov-Nabokov, 1959; Verves & Khrokalo, 2010); Volyn region (Verves & Khrokalo, 2010): Lutzk (Khanina & Khvesik, 1963); Shatsk district, environs of Svitiaz lake (Khrokalo & Verves, 2009); Zakarpattia region: Mezighiria district, Kolochava village (Verves & Khrokalo, 2010); Uzhhorod (Moskaletz, 1960).

25. *Eggisops pecchiolii* Rondani, 1862. Firstly recorded for Ukraine.

26. *Melinda gentilis* Robineau-Desvoidy, 1830. Chernivtsi region: Putila district, Shepit village (Skufyin & Khitzova, 1978); Vyzhnytsia district, Dolyshny Shepit village (Verves, 2001); Ivano-Frankivsk region (Verves, 1985b); Deliatyn town (Verves, 1985b); Lviv region (Grunin, 1970); Zakarpattia region: Mukacheve city (Verves, 2005); Mukacheve district, Siniak village (Skufyin & Khitzova, 1978).

27. *M. viridicyanea* (Robineau-Desvoidy, 1830). Chernivtsi region (Skufyin & Khitzova, 1978; Verves & Khrokalo, 2010): environs of Khotyn town (Verves, 1985b, 2005); Ivano-Frankivsk region (Verves & Khrokalo, 2010): Kosiv district, Rozhniv village (Verves, 2005); Volyn region: Shatsk district,

environs of Svitiaz lake (Khrokalo & Verves, 2009); Zakarpattia region (Skufyin & Khitzova, 1978; Verves & Khrokalo, 2010): Mezighiria district, Kolochava village (Verves, 2005).

28. *Chrysomya albiceps* (Wiedemann, 1819). Zakarpattia region (Verves & Khrokalo, 2010): Mezighiria district, Kolochava village (Verves, 2004).

29. *Phormia regina* (Meigen, 1826). Chernivtsi region (Verves, 2005; Verves & Khrokalo, 2010): Khotyn town (Verves, 1985b); Khotyn district, Stavchany village (Verves, 2005); Zaleshchyky town (Verves, 2005); Khmelnytskyi region (Belke, 1859); Zakarpattia region (Verves, 2005; Verves & Khrokalo, 2010): Uzhhorod (Moskaletz, 1960).

30. *Protophormia azurea* (Fallén, 1817). Chernivtsi region (Verves, 2005; Verves & Khrokalo, 2010): Khotyn town (Verves, 1985b); Vyzhnytsia district, Dolyshny Shepit village (Verves, 2001); Volyn region (Verves & Khrokalo, 2010): Shatsk district, environs of Svitiaz lake (Khrokalo & Verves, 2009).

31. *P. proxima* Grunin, 1966. Volyn region: Shatsk district, environs of Svitiaz lake (Khrokalo & Verves, 2009).

32. *P. rognesi* Thompson & Pont, 1993. Volyn region (Verves & Khrokalo, 2010): Shatsk district, environs of Svitiaz lake (Khrokalo & Verves, 2009).

33. *Protophormia terraenavae* (Robineau-Desvoidy, 1830). Chernivtsi region (Verves, 2005; Verves & Khrokalo, 2010): environs of Khotyn town (Verves, 1985b); Vyzhnytsia district, Dolyshny Shepit village (Verves, 2001); Khmelnytskyi region (Verves, 2005; Verves & Khrokalo, 2010; Viktorov-Nabokov, 1959); Lviv region (Verves, 2005; Verves & Khrokalo, 2010; Viktorov-Nabokov, 1959); Volyn region (Verves, 2005; Verves & Khrokalo, 2010): Lutzk (Khanina & Khvesik, 1963); Shatsk district, environs of Svitiaz lake (Khrokalo & Verves, 2009); Zakarpattia region (Verves & Khrokalo, 2010): Uzhhorod (Moskaletz, 1960).

34. *Trypocalliphora braueri* (Hendel, 1901). Chernivtsi region: Vyzhnytsia district, Lopushna village (Skufyin & Khitzova, 1978).

35. *Pollenia amentaria* (Scopoli, 1763). Chernivtsi region (Verves, 2005; Verves & Khrokalo, 2010): Khotyn town (Verves, 1985b); Novoselitsia district, Chernivka village (Skufyin & Khitzova, 1978); Vyzhnytsia district, Dolyshny Shepit village (Verves, 2001); Lopushna village (Skufyin & Khitzova, 1978);

Lviv region (Verves & Khrokalo, 2010); Volyn region (Verves & Khrokalo, 2010): Shatsk district, environs of Svitiaz lake (Khrokalo & Verves, 2009); Zakarpattia region (Verves & Khrokalo, 2010): Mezigiria district, Kolochava village (Verves, 2005).

36. *P. angustigena* Wainwright, 1940. Zakarpattia region (Verves & Khrokalo, 2010): Mezigiria district, Kolochava village (Verves, 2005).

37. *P. dasypoda* Portschinsky, 1881. Chernivtsi region (Verves & Khrokalo, 2010): Khotyn town (Verves, 2005); Vyzhnytsia district, Dolyshny Shepit village (Verves, 2001).

38. *P. griseotomentosa* (Jacentkovský, 1944). Chernivtsi region (Verves & Khrokalo, 2010): Vyzhnytsia district, Dolyshny Shepit village (Verves, 2001); Khmelnytskyi region: Chemerivtsi district, Chorna village (Verves & Khrokalo, 2010); Slavuta city (Verves, 2005); Zakarpattia region (Verves & Khrokalo, 2010): Mezigiria district, Kolochava village (Verves, 2005).

39. *P. hungarica* Rognes, 1987. Chernivtsi region (Verves & Khrokalo, 2010): Vyzhnytsia district, Dolyshny Shepit village (Verves, 2005); Volyn region (Verves & Khrokalo, 2010): Shatsk district, environs of Svitiaz lake (Khrokalo & Verves, 2009); Zakarpattia region (Verves & Khrokalo, 2010): Mezigiria district, Kolochava village (Verves, 2005).

40. *P. labialis* Robineau-Desvoidy, 1863. Chernivtsi region (Verves, 2005; Verves & Khrokalo, 2010): Khotyn town (Verves, 1985b); Novoselitzia district, Chernivka village (Skufyin & Khitzova, 1978); Putila district, Shepit village (Skufyin & Khitzova, 1978); Vyzhnytsia district, Dolyshny Shepit village (Verves, 2001); Volyn region (Verves & Khrokalo, 2010): Shatsk district, environs of Svitiaz lake (Khrokalo & Verves, 2009); Zakarpattia region (Verves & Khrokalo, 2010): Mezigiria district, Kolochava village (Verves, 2005).

41. *P. pediculata* Macquart, 1834. Ivano-Frankivsk region (Verves & Khrokalo, 2010; Verves, 2012): Deliatyn town (Verves, 2005); Lviv region (Verves & Khrokalo, 2010; Verves, 2012); Ternopil region (Verves, 2005); Zakarpattia region (Verves, 2010).

42. *P. ponti* Rognes, 1991. Chernivtsi region: Vyzhnytsia district, Dolyshny Shepit village (Verves, 2001).

43. *P. rudis* (Fabricius, 1794). Chernivtsi region (Verves & Khrokalo, 2010): environs of Khotyn town (Verves, 1985b); Novoselitzia district,

Chernivka village (Skufyin & Khitzova, 1978); Putila district, Shepit village (Skufyin & Khitzova, 1978); Vyzhnytsia district, Dolyshny Shepit village (Verves, 2001); Lopushna village (Skufyin & Khitzova, 1978); Khmelnytskyi region (Belke, 1859); Volyn region (Verves & Khrokalo, 2010): Shatsk district, environs of Svitiaz lake (Khrokalo & Verves, 2009); Zakarpattia region (Verves & Khrokalo, 2010): Mezigiria district, Kolochava village (Verves, 2005).

44. *P. vagabunda* (Meigen, 1826). Chernivtsi region (Verves & Khrokalo, 2010): Vyzhnytsia district, Dolyshny Shepit village (Verves, 2001); Volyn region (Verves & Khrokalo, 2010); Zakarpattia region (Verves & Khrokalo, 2010): Mezigiria district, Kolochava village (Verves, 2005).

45. *P. vera* Jacentkovský, 1936. “East Carpathians” (Grunin, 1970); Chernivtsi region: Novoselitzia district, Chernivka village (Skufyin & Khitzova, 1978); Vyzhnytsia district, Dolyshny Shepit village (Verves, 2001); Lopushna village (Skufyin & Khitzova, 1978).

46. *P. viatica* Robineau-Desvoidy, 1830. Chernivtsi region: Vyzhnytsia district, Dolyshny Shepit village (Verves, 2001).

47. *Eurychaeta muscaria* (Meigen, 1926). Chernivtsi region (Verves, 1998; Verves & Khrokalo, 2010); Khmelnytskyi region (Belke, 1859); Ternopil region: Zalishchyky town (Verves & Khrokalo, 2010).

48. *E. palpalis* (Robineau-Desvoidy, 1830). Chernivtsi region (Verves, 1998, 2005; Verves & Khrokalo, 2010): environs of Khotyn town (Verves, 1985b); Ivano-Frankivsk region (Verves, 1998, 2005; Verves & Khrokalo, 2010): Kosiv district (Verves, 1977); Volyn region (Verves & Khrokalo, 2010): Shatsk district, environs of Svitiaz lake (Khrokalo & Verves, 2009); Zakarpattia region (Verves, 1998, 2005; Verves & Khrokalo, 2010).

Sarcophagidae

1. *Macronychia* (s. str.) *striginervis* (Zetterstedt, 1838). Chernivtsi region (Verves, 1998); Ivano-Frankivsk region (Verves, 1998; Verves & Khrokalo, 2006, 2014a); Lviv region (Verves, 1998; Verves & Khrokalo, 2006, 2014a); Rivne region (Verves, 1998; Verves & Khrokalo, 2006, 2014a); Zakarpattia region (Verves, 1998; Verves & Khrokalo, 2006, 2014a).

2. *M. (Moschusa) agrestis* (Fallén, 1810). Volyn region (Verves, 1998; Verves & Khrokalo, 2014a).

3. *M. (M.) griseola* (Fallén, 1820). Chernivtsi region (Verves, 1998; Verves & Khrokalo, 2014a); Ivano-Frankivsk region (Verves, 1998; Verves & Khrokalo, 2006, 2014a); Lviv region (Verves, 1998; Verves & Khrokalo, 2006, 2014a); Rivne region (Verves, 1998; Verves & Khrokalo, 2006, 2014a); Ternopil region (Verves, 1998; Verves & Khrokalo, 2006, 2014a); Zakarpattia region (Verves, 1998; Verves & Khrokalo, 2006, 2014a).
4. *M. (M.) polyodon* (Meigen, 1824). Chernivtsi region (Verves & Khrokalo, 2014a): Vyzhnytsia district, Dolyshny Shepit village (Verves, 2001); Lopushna village (Khitzova, 1976; Verves & Khrokalo, 2006); Ivano-Frankivsk region (Verves, 1998); Lviv region (Verves, 1998): Busk district, Krasne station (Verves & Khrokalo, 2006); Ternopil region (Verves, 1998; Verves & Khrokalo, 2006); Volyn region (Verves, 1982); Zakarpattia region (Verves, 1998; Verves & Khrokalo, 2006, 2014a).
5. *Senotainia (Arrenopus) albifrons* (Rondani, 1859). Chernivtsi region (Verves, 1998; Verves & Khrokalo, 2014a); Zakarpattia region (Verves, 1998; Verves & Khrokalo, 2014a).
6. *S. (s. str.) conica* (Fallén, 1810). Ivano-Frankivsk region (Verves, 1998; Verves & Khrokalo, 2014a); Lviv region (Verves, 1998; Verves & Khrokalo, 2014a); Volyn region (Verves & Khrokalo, 2014a): Shatsk district, environs of Svitiaz lake (Khrokalo & Verves, 2009); Zakarpattia region (Verves, 1998; Verves & Khrokalo, 2014a).
7. *Pterella grisea* (Meigen, 1824). Ivano-Frankivsk region (Verves & Khrokalo, 2014a), Khmelnytskyi region (Verves, 1998; Verves & Khrokalo, 2014a); Ternopil region (Verves, 1998; Verves & Khrokalo, 2014a); Zakarpattia region (Verves, 1998; Verves & Khrokalo, 2014a).
8. *P. melanura* (Meigen, 1824). Khmelnytskyi region (Verves & Khrokalo, 2014a).
9. *Miltogramma brevipila* Villeneuve, 1911. Firstly recorded for West Ukraine.
10. *M. germari* Meigen, 1824. Rivne region: Dibrovytzia town (Verves & Khrokalo, 2014a).
11. *M. oestracea* (Fallén, 1820). Ternopil region (Verves, 1998; Verves & Khrokalo, 2014a).
12. *M. punctata* Meigen, 1824. Khmelnytskyi region (Draber-Mońko, 1973; Verves, 1998; Verves & Khrokalo, 2014a); Ternopil (Draber-Mońko, 1973).
13. *Miltogrammidium rutilans* (Meigen, 1824). Khmelnytskyi region (Verves & Khrokalo, 2014a).
14. *Metopia argentata* Macquart, 1850. Ivano-Frankivsk region (Verves & Khrokalo, 2014a): Kosiv district (Verves, 1977); Lviv region (Verves & Khrokalo, 2014a).
15. *M. argyrocephala* Meigen, 1824. Chernivtsi region (Verves, 1998; Verves & Khrokalo, 2014a): Vyzhnytsia district, Dolyshny Shepit village (Verves, 2001); Ivano-Frankivsk region (Verves, 1998; Verves & Khrokalo, 2014a): Kosiv district (Verves, 1977); Lviv region (Verves, 1998; Verves & Khrokalo, 2014a); Ternopil region (Verves, 1998; Verves & Khrokalo, 2014a); Zakarpattia region (Verves, 1998; Verves & Khrokalo, 2014a).
16. *M. campestris* (Fallén, 1810). Chernivtsi region (Verves & Khrokalo, 2014a): Vyzhnytsia district, Dolyshny Shepit village (Verves, 2001); Ivano-Frankivsk region (Verves, 1998; Verves & Khrokalo, 2014a); Khmelnytskyi region (Verves, 1998; Verves & Khrokalo, 2014a); Lviv region (Verves, 1998; Verves & Khrokalo, 2014a); Volyn region (Verves & Khrokalo, 2014a): Shatsk district, environs of Svitiaz lake (Khrokalo & Verves, 2009); Zakarpattia region (Verves, 1998; Verves & Khrokalo, 2014a).
17. *M. grandii* Venturi, 1953. Chernivtsi region (Verves & Khrokalo, 2014a): Vyzhnytsia district, Dolyshny Shepit village (Verves, 2001); Zakarpattia region (Verves, 1998; Verves & Khrokalo, 2014a).
18. *M. italiana* Pape, 1985. Lviv region (Verves, 1998; Verves & Khrokalo, 2014a).
19. *M. staegeri* Rondani, 1859. Ivano-Frankivsk region (Verves, 1998; Verves & Khrokalo, 2014a): Kosiv district (Verves, 1977); Zakarpattia region (Verves, 1998; Verves & Khrokalo, 2014a).
20. *Hilarella hilarella* (Zetterstedt, 1844). Zakarpattia region (Verves, 1998; Verves & Khrokalo, 2014a).
21. *H. stictica* (Meigen, 1830). Lviv region (Verves, 1998; Verves & Khrokalo, 2014a); Ternopil region (Verves, 1998; Verves & Khrokalo, 2014a).
22. *Paragusia elegantula* (Zetterstedt, 1844). Volyn region (Verves, 1998; Verves & Khrokalo, 2014a).
23. *Taxigramma heteroneura* (Meigen, 1830). Lviv region (Verves, 1998; Verves & Khrokalo, 2014a); Ternopil region (Verves, 1998; Verves & Khrokalo, 2014a); Volyn region (Verves & Khrokalo, 2014a).

Shatsk district, environs of Svitiaz lake (Khrokalo & Verves, 2009); Zakarpattia region (Verves, 1998; Verves & Khrokalo, 2014a).

24. *Amobia signata* (Meigen, 1824). Firstly recorded for West Ukraine.

25. *Nyctia halterata* (Panzer, 1798). Chernivtsi region: Vyzhnytsia district, Dolysny Shepit village (Verves, 2001); Ivano-Frankivsk region (Verves, 1998; Verves & Khrokalo, 2014a); Kosiv district (Verves, 1977); Khmelnytskyi region (Verves, 1998; Verves & Khrokalo, 2014a); Ternopil region (Verves, 1998; Verves & Khrokalo, 2014a); Zakarpattia region (Verves, 1998; Verves & Khrokalo, 2014a).

26. *Agria affinis* (Fallén, 1817). Chernivtsi region (Verves, 1998; Verves & Khrokalo, 2014a); Vyzhnytsia district, Dolysny Shepit village (Verves, 2001); Lopushna village (Khitzova, 1976); Ivano-Frankivsk region (Verves, 1998; Verves & Khrokalo, 2014a); Kosiv district (Verves, 1977); Lviv region (Verves, 1998; Verves & Khrokalo, 2014a); Zakarpattia region (Verves, 1998; Verves & Khrokalo, 2014a).

27. *A. mamillata* (Pandellé, 1896). Ivano-Frankivsk region (Verves, 1998; Verves & Khrokalo, 2014a); Kosiv district (Verves, 1977); Lviv region (Verves, 1998; Verves & Khrokalo, 2014a); Zakarpattia (Verves, 1982; Verves & Khrokalo, 2014a).

28. *Brachicoma devia* (Fallén, 1820). Chernivtsi region (Verves, 1998; Verves & Khrokalo, 2014a); environs of Khotyn town (Verves, 1985b); Novoselitzia district, Chernivka village (Khitzova, 1976); Vyzhnytsia district, Dolysny Shepit village (Verves, 2001); Lopushna village (Khitzova, 1976); Ivano-Frankivsk region (Verves, 1998; Verves & Khrokalo, 2014a); Kosiv district (Verves, 1977); Khmelnytskyi region (Verves, 1998; Verves & Khrokalo, 2014a); Lviv region (Verves, 1982, 1998; Verves & Khrokalo, 2014a); Volyn region (Verves, 1998; Verves & Khrokalo, 2014a); Shatsk district, environs of Svitiaz lake (Khrokalo & Verves, 2009); Zakarpattia region (Verves, 1998; Verves & Khrokalo, 2014a); Mukacheve district, Syniak village (Khitzova, 1976).

29. *Sarcophila latifrons* (Fallén, 1817). Ivano-Frankivsk region (Verves, 1998; Verves & Khrokalo, 2014a); Khmelnytskyi region (Verves, 1998; Verves & Khrokalo, 2014a); Lviv region (Verves, 1998; Verves & Khrokalo, 2014a); Rivne region (Verves, 1998; Verves & Khrokalo, 2014a); Volyn region (Verves & Khrokalo, 2014a); Shatsk district,

environs of Svitiaz lake (Khrokalo & Verves, 2009); Zakarpattia region (Verves, 1998; Verves & Khrokalo, 2014a).

30. *S. meridionalis* Verves, 1982. Khmelnytskyi region (Verves & Khrokalo, 2014a).

31. *Wohlfahrtia magnifica* (Schiner, 1862). Zakarpattia region (Verves & Khrokalo, 2014a).

32. *W. meigeni* (Schiner, 1862). Chernivtsi region (Verves & Khrokalo, 2014a); Vyzhnytsia district, Dolysny Shepit village (Verves, 2001); Khmelnytskyi region (Verves, 1998; Verves & Khrokalo, 2014a); Lviv region (Verves, 1998; Verves & Khrokalo, 2014a); Ternopil region (Verves, 1998; Verves & Khrokalo, 2014a); Volyn region (Verves, 1998; Verves & Khrokalo, 2014a); Zakarpattia region (Verves, 1998; Verves & Khrokalo, 2014a).

33. *Sarcotachinella sinuata* (Meigen, 1826). Chernivtsi region (Verves, 1998); Vyzhnytsia district, Dolysny Shepit village (Verves, 2001); Ivano-Frankivsk region: Kosiv district (Verves, 1977); Khmelnytskyi region (Verves, 1998); Ternopil region (Verves, 1998); Volyn region (Verves, 1998); Zakarpattia (Verves, 1998); Rakhiv (Verves, 1974).

34. *Blaesoxipha grylloctona* Löw, 1861. Firstly recorded for West Ukraine.

35. *B. laticornis* (Meigen, 1826). Chernivtsi region (Verves & Khrokalo, 2014b); Vyzhnytsia district, Dolysny Shepit village (Verves, 2001); Rivne region (Verves, 1998; Verves & Khrokalo, 2014b); Zakarpattia (Verves, 1998; Verves & Khrokalo, 2014b); Rakhiv (Verves, 1974).

36. *B. redempta* (Pandellé, 1896). Ivano-Frankivsk region (Verves, 1998; Verves & Khrokalo, 2014b); Kosiv district (Verves, 1977); Khmelnytskyi region (Verves, 1998; Verves & Khrokalo, 2014b); Ternopil region (Verves, 1998; Verves & Khrokalo, 2014b); Zakarpattia region (Verves, 1998; Verves & Khrokalo, 2014b); Berehove district, Rafainove village (Staněk, 1974); Merzigiria district, Kolochava village (Verves & Khrokalo, 2014b); Uzhgorod District: Nyzhne Solotvyno village (Verves & Khrokalo, 2014b).

37. *Servaisia* (s. str.) *erythrura* (Meigen, 1826). Zakarpattia region (Verves, 1998; Verves & Khrokalo, 2014b).

38. *S.* (s. str.) *rossica* (Villeneuve, 1912). Khmelnytskyi region (Verves, 1998; Verves & Khrokalo, 2014b); Ternopil region (Verves, 1998;

Verves & Khrokalo, 2014b); Zakarpattia region (Verves, 1998; Verves & Khrokalo, 2014b); Berehove district, Rafainove village (Staněk, 1974).

39. *Tephromyia grisea* (Meigen, 1826). Khmelnytskyi region (Draber-Moňko, 1973; Verves, 1998; Verves & Khrokalo, 2014b); Ternopil (Draber-Moňko, 1973); Volyn region (Verves, 1998; Verves & Khrokalo, 2014b).

40. *Ravinia pernix* (Harris, 1780). Chernivtsi region (Verves, 1998): Novoselitzia district, Chernivka village (Khitzova, 1976); Putila district, Shepit village (Khitzova, 1976); Vyzhnytsia district, Dolyshny Shepit village (Verves, 2001); Ivano-Frankivsk region (Verves, 1998): Kosiv district (Verves, 1977); Khmelnytskyi region (Verves, 1998); Lviv region (Verves, 1998); Rivne region (Verves, 1998); Ternopil region (Verves, 1998); Volyn region (Verves, 1998); Zakarpattia region (Verves, 1998); Berehove district, Rafainove village (Staněk, 1974).

41. *Helicophagella* (s. str.) *agnata* (Rondani, 1860). Chernivtsi region (Verves & Khrokalo, 2014b): Vyzhnytsia district, Dolyshny Shepit village (Verves, 2001); Ivano-Frankivsk region (Verves, 1998; Verves & Khrokalo, 2014b): Kosiv district (Verves, 1977); Zakarpattia region (Verves, 1998; Verves & Khrokalo, 2014b): Berehove district, Rafainove village (Staněk, 1974).

42. *H.* (s. str.) *crassimargo* (Pandellé, 1896). Chernivtsi region (Verves, 1998; Verves & Khrokalo, 2014b): Novoselitzia district, Chernivka village (Khitzova, 1976); Putila district, Shepit village (Khitzova, 1976); Vyzhnytsia district, Dolyshny Shepit village (Verves, 2001); Lopushna village (Khitzova, 1976); Ivano-Frankivsk region (Verves, 1998; Verves & Khrokalo, 2014b): Kosiv district (Verves, 1977); Volyn region (Verves & Khrokalo, 2014b): Shatsk district, environs of Svitiaz lake (Khrokalo & Verves, 2009); Zakarpattia region (Verves, 1998; Verves & Khrokalo, 2014b): Berehove district, Rafainove village (Staněk, 1974).

43. *H.* (s. str.) *noverca* (Rondani, 1860). Chernivtsi region (Verves, 1998; Verves & Khrokalo, 2014b): environs of Khotyn town (Verves, 1985b); Vyzhnytsia district, Dolyshny Shepit village (Verves, 2001); Ivano-Frankivsk region (Verves, 1998; Verves & Khrokalo, 2014b): Kosiv district (Verves, 1977); Zakarpattia region (Verves, 1998): Berehove district, Rafainove village (Staněk, 1974); Uzhgorod District, Nyzhne Solotvyno village (Verves & Khrokalo, 2014b).

44. *H.* (s. str.) *novercoides* (Böttcher, 1913). Chernivtsi region (Verves, 1998, 2001; Verves & Khrokalo, 2014b): Novoselitzia district, Chernivka village (Khitzova, 1976); Vyzhnytsia district, Lopushna village (Khitzova, 1976); Ivano-Frankivsk region: Kosiv district (Verves, 1977).

45. *H.* (s. str.) *rosellei* (Böttcher, 1912). Chernivtsi region (Verves & Khrokalo, 2014b): Vyzhnytsia district, Dolyshny Shepit village (Verves, 2001); Ivano-Frankivsk region (Verves, 1998; Verves & Khrokalo, 2014b): Kosiv district (Verves, 1977); Zakarpattia region: Berehove district, Rafainove village (Staněk, 1974); Mezigitia district, Kolochava village (Verves & Khrokalo, 2014b).

46. *H. (Parabellieria) melanura* (Meigen, 1826). Chernivtsi region (Verves, 1998; Verves & Khrokalo, 2014b): environs of Khotyn town (Verves, 1985b); Novoselitzia district, Chernivka village (Khitzova, 1976); Putila district, Shepit village (Khitzova, 1976); Vyzhnytsia district, Dolyshny Shepit village (Verves, 2001); Ivano-Frankivsk region (Verves, 1998; Verves & Khrokalo, 2014b): Kosiv district (Verves, 1977); Khmelnytskyi region (Verves, 1998; Verves & Khrokalo, 2014b); Lviv region (Verves, 1998; Verves & Khrokalo, 2014b); Rivne region (Verves, 1998; Verves & Khrokalo, 2014b); Ternopil region (Verves, 1998; Verves & Khrokalo, 2014b); Volyn region (Verves, 1998; Verves & Khrokalo, 2014b): Shatsk district, environs of Svitiaz lake (Khrokalo & Verves, 2009); Zakarpattia region (Verves, 1998): Berehove district, Rafainove village (Staněk, 1974); Uzhgorod District, Nyzhne Solotvyno village (Verves & Khrokalo, 2014b).

47. *Discachaeta arcipes* (Pandellé, 1896). Ternopil region (Verves, 1998; Verves & Khrokalo, 2014b): Pidgora village (Verves & Kuzmovich, 1979); environs of Ternopil (Verves & Kuzmovich, 1979); Zastinoche village (Verves & Kuzmovich, 1979).

48. *D. pumila* (Meigen, 1826). Ivano-Frankivsk region (Verves, 1998): Kosiv district (Verves, 1977; Verves & Khrokalo, 2014b); Khmelnytskyi region (Verves, 1998; Verves & Khrokalo, 2014b); Ternopil region (Verves, 1998; Verves & Khrokalo, 2014b).

49. *Heteronychia* (s. str.) *bulgarica* (Enderlein, 1936). Volyn region (Verves, 1998; Verves & Khrokalo, 2014b).

50. *H.* (s. str.) *consanguinea* (Rondani, 1860). Chernivtsi region (Verves, 1998; Verves & Khrokalo, 2014b); Zakarpattia region: Mukacheve district, Syniak village (Khitzova, 1976).

51. *H. (s. str.) depressifrons* (Zetterstedt, 1845). Chernivtsi region (Verves, 1998; Verves & Khrokalo, 2014b): Putila district, Shepit village (Khitzova, 1976); Vyzhnytsia district, Dolyshny Shepit village (Verves, 2001); Lopushna village (Khitzova, 1976); Ivano-Frankivsk region (Verves, 1998; Verves & Khrokalo, 2014b): Kosiv district (Verves, 1977); Volyn region (Verves & Khrokalo, 2014b): Shatsk district, environs of Svitiaz lake (Khrokalo & Verves, 2009); Zakarpattia region (Verves, 1998): Uzhgorod District, Nyzhne Solotvyno village (Verves & Khrokalo, 2014b).

52. *H. (s. str.) dissimilis* (Meigen, 1826). Chernivtsi region (Verves, 1998; Verves & Khrokalo, 2014b): Novoselitzia district, Chernivka village (Khitzova, 1976); Putila district, Shepit village (Khitzova, 1976); Vyzhnytsia district, Lopushna village (Khitzova, 1976); Ivano-Frankivsk region (Verves, 1998; Verves & Khrokalo, 2014b): Kosiv district (Verves, 1977); Khmelnytskyi region (Verves, 1998; Verves & Khrokalo, 2014b); Rivne region (Verves, 1998; Verves & Khrokalo, 2014b); Ternopil region (Verves, 1998; Verves & Khrokalo, 2014b); Volyn region (Verves, 1998; Verves & Khrokalo, 2014b); Zakarpattia region: Mezigiria district, Kolochava village (Verves & Khrokalo, 2014b); Rakhiv town (Verves, 1974).

53. *H. (s. str.) haemorrhoea* (Meigen, 1826). Chernivtsi region (Verves, 1998; Verves & Khrokalo, 2014b): environs of Khotyn town (Verves, 1985b); Ivano-Frankivsk region (Verves & Khrokalo, 2014b): Kosiv district (Verves, 1977, 1079b); Zakarpattia region (Verves, 1998; Verves & Khrokalo, 2014b).

54. *H. (s. str.) haemorrhoides* (Böttcher, 1913). Chernivtsi region (Verves, 1998; Verves & Khrokalo, 2014b); Ivano-Frankivsk region (Verves, 1998; Verves & Khrokalo, 2014b): Kosiv district (Verves, 1977); Khmelnytskyi region (Verves, 1998; Verves & Khrokalo, 2014b); Lviv region (Verves, 1998; Verves & Khrokalo, 2014b); Ternopil region (Verves, 1998; Verves & Khrokalo, 2014b); Volyn region (Verves & Khrokalo, 2014b): Shatsk district, environs of Svitiaz lake (Khrokalo & Verves, 2009); Zakarpattia region (Verves, 1998; Verves & Khrokalo, 2014b).

55. *H. (s. str.) proxima* (Rondani, 1860). Chernivtsi region (Verves, 1998; Verves & Khrokalo, 2014b): environs of Khotyn town (Verves, 1985b); Novoselitzia district, Chernivka village (Khitzova, 1976); Putila district, Shepit village (Khitzova, 1976); Ivano-Frankivsk region (Verves & Khrokalo, 2014b): Kosiv district (Verves, 1977); Lviv region

(Verves, 1998; Verves & Khrokalo, 2014b); Volyn region (Verves, 1998; Verves & Khrokalo, 2014b); Zakarpattia region (Verves, 1998): Uzhgorod District, Nyzhne Solotvyno village (Verves & Khrokalo, 2014b).

56. *H. (s. str.) rohdendorfi* (Povolný & Slamečková, 1959). Chernivtsi region (Verves & Khrokalo, 2014b): Vyzhnytsia district, Dolyshny Shepit village (Verves, 2001); Ivano-Frankivsk region: Kosiv district (Verves, 1977); Zakarpattia region (Verves, 1998; Verves & Khrokalo, 2014b).

57. *H. (s. str.) rohdendorfiana* Mihályi, 1975. Chernivtsi region: Vyzhnytsia district, Dolyshny Shepit village (Verves, 2001); Ivano-Frankivsk region (Verves, 1998): Kosiv district (Verves, 1977); Zakarpattia region (Verves, 1998): Mezigiria district, Kolochava village (Verves & Khrokalo, 2014b).

58. *H. (s. str.) schineri* (Bezzi, 1891). Chernivtsi region (Verves, 1998; Verves & Khrokalo, 2014b): environs of Khotyn town (Verves, 1985b); Vyzhnytsia district, Dolyshny Shepit village (Verves, 2001); Lopushna village (Khitzova, 1976); Ivano-Frankivsk region (Verves, 1998; Verves & Khrokalo, 2014b): Kosiv district (Verves, 1977); Ternopil region: Zalishchyky town (Verves & Khrokalo, 2014b); Zakarpattia region (Verves, 1998; Verves & Khrokalo, 2014b): Berehove district, Rafainove village (Staněk, 1974).

59. *H. (s. str.) slovaca* Povolný & Slamečková, 1967. Ivano-Frankivsk region (Verves, 1998; Verves & Khrokalo, 2014b): Kosiv district (Verves, 1977, 1979b).

60. *H. (s. str.) vagans* (Meigen, 1826). Chernivtsi region (Verves, 1998; Verves & Khrokalo, 2014b): Novoselitzia district, Chernivka village (Khitzova, 1976); Putila district, Shepit village (Khitzova, 1976); Ivano-Frankivsk region (Verves & Khrokalo, 2014b): Kosiv district (Verves, 1977); Khmelnytskyi region (Verves, 1998; Verves & Khrokalo, 2014b); Lviv region (Verves, 1998; Verves & Khrokalo, 2014b); Rivne region (Verves, 1998; Verves & Khrokalo, 2014b); Ternopil region (Verves, 1998; Verves & Khrokalo, 2014b); Volyn region (Verves & Khrokalo, 2014b): Shatsk district, environs of Svitiaz lake (Khrokalo & Verves, 2009); Zakarpattia region (Verves, 1998; Verves & Khrokalo, 2014b): Berehove district, Rafainove village (Staněk, 1974).

61. *H. (s. str.) vicina* (Macquart, 1835). Chernivtsi region (Verves, 1998; Verves & Khrokalo, 2014b): Putila district, Shepit village (Khitzova, 1976); Vyzhnytsia district, Dolyshny Shepit village (Verves,

2001); Lopushna village (Khitzova, 1976); Volyn region (Verves & Khrokalo, 2014b): Shatsk district, environs of Svitiaz lake (Khrokalo & Verves, 2009).

62. *H. (Pandelleola) filia* (Rondani, 1860). Chernivtsi region: environs of Khotyn town (Verves, 1985b).

63. *Karovia hirticrus* (Pandellé, 1896). Chernivtsi region (Verves, 1998; Verves & Khrokalo, 2014b): environs of Khotyn town (Verves, 1985b); Ivano-Frankivsk region (Verves, 1998; Verves & Khrokalo, 2014b); Zakarpattia region (Verves, 1998; Verves & Khrokalo, 2014b).

64. *Asceloctella (Mimarhopocnemis) granulata* (Kramer, 1908). Chernivtsi region (Verves, 1998, 2001; Verves & Khrokalo, 2014b): Vyzhnytsia district, Lopushna village (Khitzova, 1976).

65. *Bellieriomima subulata* (Pandellé, 1896). Chernivtsi region (Verves, 1998; Verves & Khrokalo, 2014b): environs of Khotyn town (Verves, 1985b); Novoselitzia district, Chernivka village (Khitzova, 1976); Putila district, Shepit village (Khitzova, 1976); Vyzhnytsia district, Lopushna village (Khitzova, 1976); Ivano-Frankivsk region (Verves, 1998; Verves & Khrokalo, 2014b): Kosiv district (Verves, 1977); Volyn region (Verves & Khrokalo, 2014b): Shatsk district, environs of Svitiaz lake (Khrokalo & Verves, 2009); Zakarpattia region (Verves, 1998; Verves & Khrokalo, 2014b): Berehove district, Rafainove village (Staněk, 1974).

66. *Krameromyia anaces* (Walker, 1849). Chernivtsi region (Verves, 1998; Verves & Khrokalo, 2014b): environs of Khotyn town (Verves, 1985b); Zakarpattia region (Verves, 1998; Verves & Khrokalo, 2014b).

67. *Myorhina (Mehria) nemoralis* (Kramer, 1908). Chernivtsi region (Verves, 1998; Verves & Khrokalo, 2014b): Putila district, Shepit village (Khitzova, 1976); Vyzhnytsia district, Dolyshny Shepit village (Verves, 2001); Ivano-Frankivsk region (Verves, 1998; Verves & Khrokalo, 2014b): Kosiv district (Verves, 1977); Zakarpattia region (Verves, 1998; Verves & Khrokalo, 2014b).

68. *M. (s. str.) lunigera* (Böttcher, 1914). Chernivtsi region (Verves, 1998; Verves & Khrokalo, 2014b): Putila district, Shepit village (Khitzova, 1976); Vyzhnytsia district, Dolyshny Shepit village (Verves, 2001); Lopushna village (Khitzova, 1976); Zakarpattia region (Verves, 1998): Mezigiria district, Kolochava village (Verves & Khrokalo, 2014b).

69. *M. (s. str.) nigriventris* (Meigen, 1826). Chernivtsi region (Verves & Khrokalo, 2014b): environs of Khotyn town (Verves, 1985b); Vyzhnytsia district, Dolyshny Shepit village (Verves, 2001); Ivano-Frankivsk region (Verves, 1998; Verves & Khrokalo, 2014b): Kosiv district (Verves, 1977); Zakarpattia region (Verves, 1998; Verves & Khrokalo, 2014b).

70. *M. (s. str.) pandifera* (Blackith & Pape, 1999). Chernivtsi region (Verves & Khrokalo, 2014b): Vyzhnytsia district, Dolyshny Shepit village (Verves, 2001).

71. *M. (s. str.) socrus* (Rondani, 1860). Chernivtsi region (Verves & Khrokalo, 2014b): Vyzhnytsia district, Dolyshny Shepit village (Verves, 2001).

72. *M. (s. str.) soror* (Rondani, 1860). Chernivtsi region (Verves, 1998; Verves & Khrokalo, 2014b): Putila district, Shepit village (Khitzova, 1976); Vyzhnytsia district, Dolyshny Shepit village (Verves, 2001); Lopushna village (Khitzova, 1976); Ivano-Frankivsk region (Verves, 1998; Verves & Khrokalo, 2014b): Kosiv district (Verves, 1977); Zakarpattia region (Verves, 1998; Verves & Khrokalo, 2014b).

73. *M. (s. str.) villeneuvei* (Böttcher, 1912). Chernivtsi region (Verves, 2001; Verves & Khrokalo, 2014b): Putila district, Shepit village (Khitzova, 1976); Ivano-Frankivsk region (Verves, 1998; Verves & Khrokalo, 2014b): Kosiv district (Verves, 1977).

74. *Pandelleana protuberans* (Pandellé, 1896). Chernivtsi region (Verves & Khrokalo, 2014b): Putila district, Shepit village (Khitzova, 1976); Ivano-Frankivsk region (Verves, 1998; Verves & Khrokalo, 2014b): Kosiv district (Verves, 1977).

75. *Sarina sexpunctata* (Fabricius, 1805). Chernivtsi region (Verves & Khrokalo, 2014b): Putila district, Shepit village (Khitzova, 1976); Vyzhnytsia district, Lopushna village (Khitzova, 1976); Ivano-Frankivsk region (Verves, 1998; Verves & Khrokalo, 2014b): Kosiv district (Verves, 1977); Zakarpattia region (Verves, 1998; Verves & Khrokalo, 2014b).

76. *Thyrsocnema incisilobata* (Pandellé, 1896). Chernivtsi region (Verves, 1998; Verves & Khrokalo, 2014b): environs of Khotyn town (Verves, 1985b); Novoselitzia district, Chernivka village (Khitzova, 1976); Putila district, Shepit village (Khitzova, 1976); Vyzhnytsia district, Lopushna village (Khitzova, 1976); Ivano-Frankivsk region (Verves, 1998; Verves & Khrokalo, 2014b): Kosiv district (Verves, 1977); Khmelnytskyi region (Verves, 1998; Verves & Khrokalo, 2014b); Lviv region (Verves,

1998; Verves & Khrokalo, 2014b); Rivne region (Verves, 1998), Ternopil region (Verves, 1998; Verves & Khrokalo, 2014b); Volyn region (Verves, 1998; Verves & Khrokalo, 2014b); Zakarpattia region: Berehove district, Rafainove village (Staněk, 1974); Mezigiria district, Kolochava village (Verves & Khrokalo, 2014b); Uzhgorod (Verves, 1974); Uzhgorod District, Nyzhne Solotvyno village (Verves & Khrokalo, 2014b); Velyko-Berezna District: Vyshka village (Verves & Khrokalo, 2014b)

77. *T. kentejana* (Rohdendorf, 1937). Zakarpattia region (Verves, 1998): Mezigiria district, Kolochava village (Verves & Khrokalo, 2014b).

78. *Bercaea africa* (Wiedemann, 1824). Chernivtsi region (Verves, 1998; Verves & Khrokalo, 2014b): environs of Khotyn town (Verves, 1985b); Novoselitzia district, Chernivka village (Khitzova, 1976); Ivano-Frankivsk region (Verves, 1998; Verves & Khrokalo, 2014b); Khmelnytskyi region (Belke, 1859; Verves, 1998; Verves & Khrokalo, 2014b); Lviv region (Verves & Khrokalo, 2014b); Rivne region (Verves, 1998; Verves & Khrokalo, 2014b); Ternopil region (Verves, 1998; Verves & Khrokalo, 2014b); Volyn region (Verves, 1998; Verves & Khrokalo, 2014b); Shatsk district, environs of Svitiaz lake (Khrokalo & Verves, 2009); Zakarpattia region (Verves, 1998; Verves & Khrokalo, 2014b).

79. *Liopygia (Thomsonea) argyrostoma* (Robineau-Desvoidy, 1830). Chernivtsi region (Verves, 1998; Verves & Khrokalo, 2014b); Ivano-Frankivsk region (Verves, 1998; Verves & Khrokalo, 2014b); Zakarpattia region (Verves, 1998; Verves & Khrokalo, 2014b).

80. *L. (Variosellea) uliginosa* (Kramer, 1908). Ivano-Frankivsk region: Kosiv district (Verves, 1977); Zakarpattia region (Verves, 1998; Verves & Khrokalo, 2014b); Berehove district, Rafainove village (Staněk, 1974).

81. *Liosarcophaga* (s. str.) *emdeni* (Rohdendorf, 1969). Chernivtsi region (Verves, 1998; Verves & Khrokalo, 2014b): environs of Khotyn town (Verves, 1985b); Novoselitzia district, Chernivka village (Khitzova, 1976); Putila district, Shepit village (Khitzova, 1976); Vyzhnytsia district, Lopushna village (Khitzova, 1976); Ivano-Frankivsk region (Verves, 1998; Verves & Khrokalo, 2014b); Kosiv district (Verves, 1977); Khmelnytskyi region (Verves, 1998; Verves & Khrokalo, 2014b); Lviv region (Verves, 1998; Verves & Khrokalo, 2014b); Ternopil region (Verves, 1998; Verves & Khrokalo, 2014b); Pidgora village (Verves & Kuzmovich, 1979), environs of Ternopil (Verves & Kuzmovich,

1979); Volyn region (Verves, 1998; Verves & Khrokalo, 2014b); Zakarpattia region (Verves, 1998): Mukacheve district, Syniak village (Khitzova, 1976); Uzhgorod District, Nyzhne Solotvyno village (Verves & Khrokalo, 2014b).

82. *L. (s. str.) harpax* (Pandellé, 1896). Chernivtsi region (Verves, 1998; Verves & Khrokalo, 2014b): Vyzhnytsia district, Dolyshny Shepit village (Verves, 2001); Lopushna village (Khitzova, 1976); Ivano-Frankivsk region (Verves, 1998; Verves & Khrokalo, 2014b); Kosiv district (Verves, 1977); Zakarpattia region (Logoida, 1978; Verves, 1998; Verves & Khrokalo, 2014b); Berehove district, Rafainove village (Staněk, 1974).

83. *L. (s. str.) portschinskyi* (Rohdendorf, 1937). Chernivtsi region (Verves, 1998; Verves & Khrokalo, 2014b): Vyzhnytsia district, Lopushna village (Khitzova, 1976); Ivano-Frankivsk region (Verves, 1998; Verves & Khrokalo, 2014b); Lviv region (Verves, 1998; Verves & Khrokalo, 2014b); Volyn region (Verves, 1998; Verves & Khrokalo, 2014b); Zakarpattia region (Verves, 1998; Verves & Khrokalo, 2014b).

84. *L. (s. str.) tuberosa* (Pandellé, 1896). Chernivtsi region (Verves, 1998; Verves & Khrokalo, 2014b): Novoselitzia district, Chernivka village (Khitzova, 1976); Vyzhnytsia district, Lopushna village (Khitzova, 1976); Ivano-Frankivsk region: Kosiv district (Verves, 1977); Volyn region (Verves & Khrokalo, 2014b); Shatsk district, environs of Svitiaz lake (Khrokalo & Verves, 2009); Zakarpattia region (Logoida, 1978; Verves, 1998; Verves & Khrokalo, 2014b); Mukacheve district, Syniak village (Khitzova, 1976).

85. *L. (Pandelleisca) similis* (Meade, 1876). Chernivtsi region (Verves, 1998; Verves & Khrokalo, 2014b): environs of Khotyn town (Verves, 1985b); Novoselitzia district, Chernivka village (Khitzova, 1976); Putila district, Shepit village (Khitzova, 1976); Vyzhnytsia district, Dolyshny Shepit village (Verves, 2001); Lopushna village (Khitzova, 1976); Ivano-Frankivsk region (Verves, 1998; Verves & Khrokalo, 2014b); Kosiv district (Verves, 1977); Lviv region (Verves, 1998; Verves & Khrokalo, 2014b); Rivne region (Verves, 1998; Verves & Khrokalo, 2014b); Ternopil region (Verves, 1998; Verves & Khrokalo, 2014b); Volyn region (Verves, 1998; Verves & Khrokalo, 2014b); Shatsk district, environs of Svitiaz lake (Khrokalo & Verves, 2009); Zakarpattia region (Verves, 1998): Uzhgorod District, Nyzhne Solotvyno village (Verves & Khrokalo, 2014b).

86. *Parasarcophaga* (s. str.) *albiceps* (Meigen, 1826). Chernivtsi region (Verves, 1998; Verves & Khrokalo, 2014b): Novoselitzia district, Chernivka village (Khitzova, 1976); Putila district, Shepit village (Khitzova, 1976); Vyzhnytsia district, Dolyshny Shepit village (Verves, 2001); Lopushna village (Khitzova, 1976); Ivano-Frankivsk region (Verves, 1998; Verves & Khrokalo, 2014b): Kosiv district (Verves, 1977); Khmelnytskyi region (Verves, 1998; Verves & Khrokalo, 2014b); Lviv region (Verves, 1998; Verves & Khrokalo, 2014b); Volyn region (Verves, 1998; Verves & Khrokalo, 2014b): Shatsk district, environs of Svitiaz lake (Khrokalo & Verves, 2009); Zakarpattia region (Verves, 1998): Berehove district, Rafainove village (Staněk, 1974); Mukacheve district, Syniak village (Khitzova, 1976); Uzhgorod District, Nyzhne Solotvyno village (Verves & Khrokalo, 2014b).

87. *Robineauella* (s. str.) *caerulescens* (Zetterstedt, 1838). Chernivtsi region (Verves, 1998; Verves & Khrokalo, 2014b): environs of Khotyn town (Verves, 1985b); Novoselitzia district, Chernivka village (Khitzova, 1976); Putila district, Shepit village (Khitzova, 1976); Vyzhnytsia district, Dolyshny Shepit village (Verves, 2001); Lopushna village (Khitzova, 1976); Ivano-Frankivsk region (Verves, 1998; Verves & Khrokalo, 2014b): Kosiv district (Verves, 1977); Khmelnytskyi region (Verves, 1998; Verves & Khrokalo, 2014b); Lviv region (Verves, 1998; Verves & Khrokalo, 2014b); Rivne region (Verves, 1998; Verves & Khrokalo, 2014b); Ternopil region (Verves, 1998; Verves & Khrokalo, 2014b); Volyn region (Verves, 1998; Verves & Khrokalo, 2014b): Shatsk district, environs of Svitiaz lake (Khrokalo & Verves, 2009); Zakarpattia region (Verves, 1998): Mezigiria district, Kolochava village (Verves & Khrokalo, 2014b); Uzhgorod District, Nyzhne Solotvyno village (Verves & Khrokalo, 2014b).

88. *Kramerea schuetzei* (Kramer, 1909). Ivano-Frankivsk region (Verves, 1998; Xue *et al.*, 2011): Kosiv district (Verves, 1977); Khmelnytskyi region (Verves, 1998; Xue *et al.*, 2011); Volyn region: Shatsk district, environs of Svitiaz lake (Khrokalo & Verves, 2009); Zakarpattia region (Verves, 1998; Xue *et al.*, 2011): Berehove district, Rafainove village (Staněk, 1974).

89. *Rosellea aratrix* (Pandellé, 1896)*. Chernivtsi region (Verves, 1998; Xue *et al.*, 2011): environs of Khotyn town (Verves, 1985b); Novoselitzia district, Chernivka village (Khitzova, 1976); Putila district, Shepit village (Khitzova, 1976); Vyzhnytsia district, Dolyshny Shepit village (Verves, 2001); Lopushna

village (Khitzova, 1976); Ivano-Frankivsk region (Verves, 1998; Xue *et al.*, 2011): Kosiv district (Verves, 1977); Volyn region (Verves, 1998; Xue *et al.*, 2011): Shatsk district, environs of Svitiaz lake (Khrokalo & Verves, 2009); Zakarpattia region (Verves, 1998; Xue *et al.*, 2011): Berehove district, Rafainove village (Staněk, 1974); Mukacheve district, Syniak village (Khitzova, 1976).

*Data “Zakarpattia: Pivtzy” (Verves, 1974) really belongs to Pivtzy village (Chernigiv region).

90. *Sarcophaga bachmayeri* (Lehrer, 1978). Zakarpattia (Povolný & Verves, 1986; Verves, 1998): Perechyn district, Turyi Remety village (Verves & Khrokalo, 2014b); Rakhiv town (Verves & Khrokalo, 2014b); Velyko-Berezhny town (Verves & Khrokalo, 2014b).

91. *S. carnaria* (Linnaeus, 1758). Chernivtsi region (Verves, 1998; Verves & Khrokalo, 2014b): environs of Khotyn town (Verves, 1985b); Vyzhnytsia district, Dolyshny Shepit village (Verves, 2001); Ivano-Frankivsk region (Verves, 1998; Verves & Khrokalo, 2014b): Kosiv district (Verves, 1977); Lviv region (Verves, 1998; Verves & Khrokalo, 2014b); Rivne region (Verves, 1998; Verves & Khrokalo, 2014b); Volyn region (Verves, 1998; Verves & Khrokalo, 2014b): Shatsk district, environs of Svitiaz lake (Khrokalo & Verves, 2009); Zakarpattia region (Verves, 1998): Mezigiria district, Kolochava village (Verves & Khrokalo, 2014b); Uzhgorod District, Nyzhne Solotvyno village (Verves & Khrokalo, 2014b).

92. *S. disputata* Lehrer, 1967. Zakarpattia region (Verves & Radchenko, 2017).

93. *S. hennigi* Lehrer, 1978. Zakarpattia region: Uzhgorod District, Nyzhne Solotvyno village (Verves & Khrokalo, 2014b).

94. *S. jupalnica* Lehrer, 1967. Chernivtsi region*; Ivano-Frankivsk region: Kosiv district, Rozhniv village (Verves & Khrokalo, 2014b).

*After Khitzova (1976), who listed this species under erroneous name “*Sarcophaga bergi* Rohdendorf, 1937”.

95. *S. lehmanni* Müller, 1922. Chernivtsi region (Verves, 1998; Verves & Khrokalo, 2014b): environs of Khotyn town (Verves, 1985b); Novoselitzia district, Chernivka village (Khitzova, 1976); Putila district, Shepit village (Khitzova, 1976); Vyzhnytsia district, Lopushna village (Khitzova, 1976); Ivano-Frankivsk region (Verves, 1998; Verves & Khrokalo,

2014b): Kosiv district (Verves, 1977); Khmelnytskyi region (Verves, 1998; Verves & Khrokalo, 2014b); Lviv region (Verves, 1998; Verves & Khrokalo, 2014b); Rivne region (Verves, 1998; Verves & Khrokalo, 2014b); Ternopil region (Verves, 1998; Verves & Khrokalo, 2014b); Volyn region (Verves & Khrokalo, 2014b): Shatsk district, environs of Svitiaz lake (Khrokalo & Verves, 2009); Zakarpattia region (Verves, 1998): Berehove city (Verves, 1974); Berehove district, Rafainove village (Staněk, 1974); Uzhgorod (Verves, 1974); Uzhgorod District, Nyzhne Solotvyno village (Verves & Khrokalo, 2014b).

96. *S. moldavica* Rohdendorf, 1937. Chernivtsi region (Povolný & Verves, 1986; Verves, 1998; Verves & Khrokalo, 2014b): Novoselitzia district, Chernivka village (Khitzova, 1976); Zakarpattia region (Povolný & Verves, 1986; Verves, 1998): Mezigiria district, Kolochava village (Verves & Khrokalo, 2014b); Mukacheve district, Syniak village (Khitzova, 1976); Putila district, Shepit village (Khitzova, 1976).

97. *S. mouchajosefi* Lehrer, 1978 Zakarpattia region: Rakhiv district (Verves & Khrokalo, 2014b).

98. *S. schusteri* Lehrer, 1959. Chernivtsi region: Vyzhnytsia district, Dolyshny Shepit village (Verves & Khrokalo, 2014b); Zakarpattia region: Mezigiria district, Kolochava village (Verves & Khrokalo, 2014b); Uzhgorod District, Nyzhne Solotvyno village (Verves & Khrokalo, 2014b).

99. *S. subvicina* Rohdendorf, 1937. Chernivtsi region (Verves, 1998; Verves & Khrokalo, 2014b): environs of Chernivtsi city (Khitzova, 1976); environs of Khotyn town (Verves, 1985b); Novoselitzia district, Chernivka village (Khitzova, 1976); Putila district, Shepit village (Khitzova, 1976); Vyzhnytsia district, Dolyshny Shepit village (Verves, 2001); Lopushna village (Khitzova, 1976); Ivano-Frankivsk region: Kosiv district (Verves, 1977); Khmelnytskyi region (Verves, 1998; Verves & Khrokalo, 2014b); Lviv region (Verves, 1998; Verves & Khrokalo, 2014b); Rivne region (Verves, 1998); Zakarpattia region (Verves, 1998): Berehove district, Rafainove village (Staněk, 1974); Mezigiria district, Kolochava village (Verves & Khrokalo, 2014b); Mukacheve district, Syniak village (Khitzova, 1976).

100. *S. variegata* (Scopoli, 1763). Chernivtsi region (Verves, 1998; Verves & Khrokalo, 2014b): environs

of Khotyn town (Verves, 1985b); Novoselitzia district, Chernivka village (Khitzova, 1976); Putila district, Shepit village (Khitzova, 1976); Vyzhnytsia district, Dolyshny Shepit village (Verves, 2001); Lopushna village (Khitzova, 1976); Ivano-Frankivsk region (Verves, 1998; Verves & Khrokalo, 2014b): Kosiv district (Verves, 1977); Khmelnytskyi region (Verves, 1998; Verves & Khrokalo, 2014b); Lviv region (Verves, 1998; Verves & Khrokalo, 2014b); Rivne region (Verves, 1998; Verves & Khrokalo, 2014b); Ternopil region (Verves, 1998; Verves & Khrokalo, 2014b); Volyn region (Verves, 1998; Verves & Khrokalo, 2014b): Shatsk district, environs of Svitiaz lake (Khrokalo & Verves, 2009); Zakarpattia region (Verves, 1998): Berehove district, Rafainove village (Staněk, 1974); Mezigiria district, Kolochava village (Verves & Khrokalo, 2014b); Rakhiv city (Verves, 1974); Uzhgorod District, Nyzhne Solotvyno village (Verves & Khrokalo, 2014b).

101. *S. zumptiana* Lehrer, 1959. Ivano-Frankivsk region (Povolný & Verves, 1986; Verves, 1998; Verves & Khrokalo, 2014b): Kosiv district (Verves, 1977); Zakarpattia region (Povolný & Verves, 1986; Verves, 1998): Mezigiria district, Kolochava village (Verves & Khrokalo, 2014b); Rakhiv town (Verves, 1974); Velykyi Bereznyi town, forest (Verves, 1974).

Discussion

Regional faunas of Western Ukraine are not studied in detail: their review (including the results of present paper) is given at Table 2. The regional special lists present not less than 60-70% of full special list of calliphorids in Chernivtsi (37 species) and Zakarpattia (35 species); of sarcophagids in Zakarpattia (80 species), Chernivtsi (63 species), and Ivano-Frankivsk (62 species). The faunistic lists of species at level 30-60% of full special list is known for Calliphoridae: Volyn (23 species), Lviv (15 species), Khmelnytskyi (13 species), and Ivano-Frankivsk (12 species); for Sarcophagidae: Lviv (41 species), Volyn (34 species), Khmelnytskyi (29 species) and Ternopil (29 species). The levels of faunistic studies in others regions are very low: Calliphoridae: Ternopil (6 species) and Rivne (2 species); Sarcophagidae: Rivne (17 species). One calliphorid species (*Eggisops pecchiolii*) is firstly recorded for territory of Ukraine.

Fauna of Sarcophagidae and Calliphoridae (Diptera) of the West Ukraine

Table 1. List of specimens of the species of Calliphoridae and Sarcophagidae, collected in Zakarpattia and Lviv regions in 2014-2017

No.	Species	Nyzhne Solotvyno	Dovhe	Zakarpattia sum	Truskavets (Lviv region)	Total sum of specimens
1	<i>Calliphora vicina</i>	-	-	-	1	1
2	<i>C. vomitoria</i>	-	-	-	1	1
3	<i>Lucilia ampullacea</i>	-	1	1	4	5
4	<i>L. caesar</i>	22	17	39	80	119
5	<i>L. illustris</i>	-	3	3	8	11
6	<i>L. sericata</i>	4	11	15	39	54
7	<i>L. silvarum</i>	-	4	4	1	5
8	<i>Eggisops pecchiolii</i>	-	1	1	-	1
9	<i>Chrysomya albiceps</i>	2	4	6	-	6
10	<i>Protocalliphora azurea</i>	-	2	2	-	4
11	<i>P. proxima</i>	-	1	1	-	1
12	<i>P. rognesi</i>	-	3	3	-	3
13	<i>Trypocalliphora braueri</i>	1	-	1	-	1
14	<i>Pollenia hungarica</i>	8	1	9	2	11
15	<i>P. labialis</i>	-	-	-	1	1
16	<i>P. pediculata</i>	11	11	22	6	28
17	<i>P. rudis</i>	5	2	7	-	7
18	<i>P. vera</i>	11	5	16	1*	17
18	Calliphoridae	64	66	130	134	264
19	<i>Macronychia polyodon</i>	-	2	2	-	2
20	<i>Senotainia conica</i>	-	1	1	1	2

21	<i>Amobia signata</i>	-	1	1*	-	1
22	<i>Miltogramma brevipila</i>	-	1	1*	-	1
23	<i>Pterella melanura</i>	1	-	1*	-	1
24	<i>Metopia argentata</i>	3	-	3*	-	3
25	<i>M. argyrocephala</i>	-	-	-	1	1
26	<i>M. campestris</i>	-	1	1	-	1
27	<i>M. italiana</i>	1	-	1*	-	1
27	<i>Nyctia halterata</i>	-	-	-	18*	18
29	<i>Sarcophila latifrons</i>	-	1	1	-	1
30	<i>Blaesoxipha grylloctona</i>	-	13	13*	-	13
31	<i>B. laticornis</i>	-	1	1	1*	2
32	<i>B. redempta</i>	1	6	7	-	7
33	<i>Ravinia pernix</i>	1	-	1	-	1
34	<i>Helicophagella melanura</i>	2	6	8	20	28
35	<i>H. agnata</i>	-	2	2	-	2
36	<i>H. noverca</i>	2	23	25	-	25
37	<i>Heteronychia bulgarica</i>	-	-	-	1*	1
38	<i>H. depressifrons</i>	1	4	5	-	5
39	<i>H. haemorrhoea</i>	-	2	2	2*	4
40	<i>H. haemorrhoides</i>	-	1	1	5	6
41	<i>H. proxima</i>	5	10	15	13	28
42	<i>H. rohdendoriana</i>	-	-	-	2*	2
43	<i>H. vagans</i>	-	4	4	6	10
44	<i>Karovia hirticrus</i>	-	1	1	-	1
45	<i>Bellieriomima subulata</i>	-	9	9	1*	10

Fauna of Sarcophagidae and Calliphoridae (Diptera) of the West Ukraine

46	<i>Myorhina nigriventris</i>	1	1	2	-	2
47	<i>Sarina sexpunctata</i>	1	-	1	-	1
48	<i>Thyrsocnema incisilobata</i>	2	28	30	5	35
49	<i>Bercaea africa</i>	-	1	1	-	1
50	<i>Liopygia argyrostoma</i>	-	4	4	3*	7
51	<i>Liosarcophaga emdeni</i>	11	15	26	-	26
52	<i>L. tuberosa</i>	-	4	4	-	4
53	<i>L. similis</i>	4	24	28	1	29
54	<i>Parasarcophaga albiceps</i>	2	2	4	2	6
55	<i>Robineauella caerulescens</i>	3	-	3	2	5
56	<i>Kramerea schuetzei</i>	1	-	1	1*	2
57	<i>Rosellea aratrix</i>	31	40	71	5*	76
58	<i>Sarcophaga carnaria</i>	28	88	116	66	182
59	<i>S. disputata</i>	1	-	1	-	1
60	<i>S. hennigi</i>	3	-	3	-	3
61	<i>S. lehmanni</i>	30	-	30	81	111
62	<i>S. schusteri</i>	1	-	1	5*	6
63	<i>S. subvicina</i>	-	1	1	14	15
64	<i>S. variegata</i>	34	160	194	157	351
46	Sarcophagidae	173	456	629	412	1041
Total sum of specimens		237	522	759	546	1305

Table 2. List of species of Calliphoridae and Sarcophagidae from the West Ukraine regions

No.	Species	Regions							
		Chernivtsi	Ivano-Frankivsk	Khmelnyskyi	Lviv	Rivne	Ternopil	Volyn	Zakarpattia
1	<i>Bellardia bayeri</i> (Jacentkovský, 1937)	x	x	-	x	-	-	-	x
2	<i>B. pandia</i> (Walker, 1849)	x	-	x	-	-	-	x	x
3	<i>B. polita</i> (Mik, 1884)	-	-	-	-	-	-	-	x
4	<i>B. stricta</i> (Villeneuve, 1926)	x	-	x	-	-	-	x	x
5	<i>B. viarum</i> (Robineau-Desvoidy, 1830)	x	-	-	-	-	-	-	-
6	<i>B. vulgaris</i> (Robineau-Desvoidy, 1830)	x	-	-	-	-	-	-	-
7	<i>Calliphora</i> (s. str.) <i>loewi</i> Enderlein, 1903	x	-	-	-	-	-	x	x
8	<i>C.</i> (s. str.) <i>uralensis</i> Villeneuve, 1922	x	x	-	-	-	-	x	x
9	<i>C.</i> (s. str.) <i>vicina</i> Robineau-Desvoidy, 1830	x	-	x	x	-	x	x	x
10	<i>C.</i> (s. str.) <i>vomitorea</i> (Linnaeus, 1758)	x	x	x	x	-	-	x	x
11	<i>C.</i> (<i>Steringomyia</i>) <i>stelviana</i> (Brauer & Bergenstamm, 1891)	x	-	-	-	-	-	-	-
12	<i>C.</i> (<i>S.</i>) <i>subalpina</i> (Ringdahl, 1931)	x	-	-	-	-	-	x	-

Fauna of Sarcophagidae and Calliphoridae (Diptera) of the West Ukraine

13	<i>Cynomya mortuorum</i> (Linnaeus, 1761)	x	x	-	-	-	-	x	-
14	<i>Onesia austriaca</i> Villeneuve, 1920	x	x	-	-	-	-	-	x
15	<i>O. kowarzi</i> Villeneuve, 1920	-	-	-	-	-	-	-	x
16	<i>Lucilia (Bufolucilia) bufonivora</i> ¹ Moniez, 1876	x*	-	-	-	-	x	-	-
17	<i>L. (B.) silvarum</i> (Meigen, 1826)	x	x	-	x*	-	-	x	x
18	<i>L. (s. str.) ampullacea</i> Villeneuve, 1922	-	-	-	x*	-	-	-	x
19	<i>L. (s. str.) caesar</i> (Linnaeus, 1758)	x	x	x	x	-	x	x	x
20	<i>L. (s. str.) illustris</i> (Meigen, 1826)	x	-	x	x*	-	-	x	x*
21	<i>L. (s. str.) magnicornis</i> (Siebke, 1863)	-	-	x	-	-	-	-	-
22	<i>L. (Phaenicia) regalis</i> (Meigen, 1826) ²	-	-	-	-	x*	-	-	-
23	<i>L. (P.) richardsi</i> Collin, 1926	x	-	-	-	-	-	-	-
24	<i>L. (P.) sericata</i> (Meigen, 1826)	x	-	x	x	x	x	x	x
25	<i>Eggisops pecchiolii</i> Rondani, 1862**	-	-	-	-	-	-	-	x*
26	<i>Melinda gentilis</i> Robineau-Desvoidy, 1830	x	x	-	x	-	-	-	x
27	<i>M. viridicyanea</i> (Robineau-Desvoidy, 1830)	x	x	-	-	-	-	x	x
28	<i>Chrysomya albiceps</i> (Wiedemann, 1819)	-	-	-	-	-	-	-	x
29	<i>Phormia regina</i> (Meigen, 1826)	x	-	x	-	-	-	-	x

¹ Chernivtzi region: Zaleshchyky, coast of Dnister, 20-21.05.1986 (S. Zhrazhevskiy), 2 females.

² Rivne region: 22 km N of Ostrog, 17.07.1988 (S. Zhrazhevsky), 1 male.

30	<i>Protocalliphora azurea</i> (Fallén, 1817)	x	-	-	-	-	-	x	x*
31	<i>P. proxima</i> Grunin, 1966	-	-	-	-	-	-	x	x*
32	<i>P. rognesi</i> Thompson & Pont, 1993	-	-	-	-	-	-	x	x*
33	<i>Protophormia terraenavae</i> (Robineau-Desvoidy, 1830)	x	-	x	x	-	-	x	x
34	<i>Trypocalliphora braueri</i> (Hendel, 1901)	x	-	-	-	-	-	-	x*
35	<i>Pollenia amentaria</i> (Scopoli, 1763)	x	-	-	x	-	-	x	x
36	<i>P. angustigena</i> Wainwright, 1940	-	-	-	-	-	-	-	x
37	<i>P. dasypoda</i> Portschinsky, 1881	x	-	-	-	-	-	-	-
38	<i>P. griseotomentosa</i> (Jacentkovský, 1944)	x	-	x	-	-	-	-	x
39	<i>P. hungarica</i> Rognes, 1987	x	-	-	x*	-	-	x	x
40	<i>P. labialis</i> Robineau-Desvoidy, 1863	x	-	-	x*	-	-	x	x
41	<i>P. pediculata</i> Macquart, 1834	-	x	-	x	-	x	-	x
42	<i>P. ponti</i> Rognes, 1991	x	-	-	-	-	-	-	-
43	<i>P. rudis</i> (Fabricius, 1794)	x	x	x	-	-	-	x	x
44	<i>P. vagabunda</i> (Meigen, 1826)	x	-	-	-	-	-	x	x
45	<i>P. vera</i> Jacentkovský, 1936	x	-	-	x*	-	-	-	x*
46	<i>P. viatica</i> Robineau-Desvoidy, 1830	x	-	-	-	-	-	-	-
47	<i>Eurychaeta muscaria</i> (Meigen, 1926)	x	-	x	-	-	x	-	-
48	<i>E. palpalis</i> (Robineau-Desvoidy, 1830)	x	x	-	-	-	-	x	x

Fauna of Sarcophagidae and Calliphoridae (Diptera) of the West Ukraine

Calliphoridae		37	12	13	15	2	6	23	35
1	<i>Macronychia</i> (s. str.) <i>striginervis</i> (Zetterstedt, 1838)	-	x	-	x	x	-	-	x
2	<i>M. (Moschusa) agrestis</i> (Fallén, 1810)	-	-	-	-	-	-	x	-
3	<i>M. (M.) griseola</i> (Fallén, 1820)	x	x	-	x	x	x	-	x
4	<i>M. (M.) polyodon</i> (Meigen, 1824)	x	x	-	-	-	-	-	x
5	<i>Senotainia</i> (Arrenopus) <i>albifrons</i> (Rondani, 1859)	x	-	-	-	-	-	-	x
6	<i>S. (s. str.) conica</i> (Fallén, 1810)	-	x	-	x	-	x	x	x
7	<i>Pterella grisea</i> (Meigen, 1824)	-	x	x	-	-	x	-	x
8	<i>P. melanura</i> (Meigen, 1824)	-	-	x	-	-	-	-	x*
9	<i>Miltogramma brevipila</i> Villeneuve, 1911	-	-	-	-	-	-	-	x*
10	<i>M. germari</i> Meigen, 1824	-	-	-	-	x	-	-	-
11	<i>M. oestracea</i> (Fallén, 1820)	-	-	-	-	-	x	-	-
12	<i>M. punctata</i> Meigen, 1824	-	-	x	-	-	x	-	-
13	<i>Miltogrammidium rutilans</i> (Meigen, 1824)	-	-	x	-	-	-	-	-
14	<i>Metopia argentata</i> Macquart, 1850	-	x	-	x	-	-	-	x*
15	<i>M. argyrocephala</i> Meigen, 1824	x	x	-	x	-	x	-	x
16	<i>M. campestris</i> (Fallén, 1810)	x	x	x	x	-	-	x	x
17	<i>M. grandii</i> Venturi, 1953	x	-	-	-	-	-	-	x
18	<i>M. italiana</i> Pape, 1985	-	-	-	x	-	-	-	x*
19	<i>M. staegeri</i> Rondani, 1859	-	x	-	-	-	-	-	x

20	<i>Hilarella hilarella</i> (Zetterstedt, 1844)	-	-	-	-	-	-	-	X
21	<i>H. stictica</i> (Meigen, 1830)	-	-	-	X	-	X	-	-
22	<i>Paragusia elegantula</i> (Zetterstedt, 1844)	-	-	-	-	-	-	X	-
23	<i>Taxigramma heteroneura</i> (Meigen, 1830)	-	-	-	X	-	X	X	X
24	<i>Amobia signata</i> (Meigen, 1824)	-	-	-	-	-	-	-	X*
25	<i>Nyctia halterata</i> (Panzer, 1798)	X	X	X	X*	-	X	-	X
26	<i>Agria affinis</i> (Fallén, 1817)	X	X	-	X	-	-	-	X
27	<i>A. mamillata</i> (Pandellé, 1896)	-	X	-	X	-	-	-	X
28	<i>Brachicoma devia</i> (Fallén, 1820)	X	X	X	X	-	-	X	X
29	<i>Sarcophila latifrons</i> (Fallén, 1817)	-	X	X	X	X	-	X	X
30	<i>S. meridionalis</i> Verves, 1982	-	-	X	-	-	-	-	-
31	<i>Wohlfahrtia magnifica</i> (Schiner, 1862)	-	-	-	-	-	-	-	X
32	<i>W. meigeni</i> (Schiner, 1862)	X	-	X	X	-	X	X	X
33	<i>Sarcotachinella sinuata</i> (Meigen, 1826)	X	X	X	-	-	X	X	X
34	<i>Blaesoxipha grylloctona</i> Löw, 1861	-	-	-	-	-	-	-	X*
35	<i>B. laticornis</i> (Meigen, 1826)	X	-	-	X*	X	-	-	X
36	<i>B. redempta</i> (Pandellé, 1896)	-	X	X	-	-	X	-	X
37	<i>Servaisia</i> (s. str.) <i>erythrura</i> (Meigen, 1826)	-	-	-	-	-	-	-	X
38	<i>S.</i> (s. str.) <i>rossica</i> (Villeneuve, 1912)	-	-	X	-	-	X	-	X

Fauna of Sarcophagidae and Calliphoridae (Diptera) of the West Ukraine

39	<i>Tephromyia grisea</i> (Meigen, 1826)	-	-	X	-	-	X	X	-
40	<i>Ravinia pernix</i> (Harris, 1780)	X	X	X	X	X	X	X	X
41	<i>Helicophagella</i> (s. str.) <i>agnata</i> (Rondani, 1860)	X	X	-	-	-	-	-	X
42	<i>H.</i> (s. str.) <i>crassimargo</i> (Pandellé, 1896)	X	X	-	-	-	-	X	X
43	<i>H.</i> (s. str.) <i>noverca</i> (Rondani, 1860)	X	X	-	-	-	-	-	X
44	<i>H.</i> (s. str.) <i>novercoides</i> (Böttcher, 1913)	X	X	-	-	-	-	-	-
45	<i>H.</i> (s. str.) <i>rosellei</i> (Böttcher, 1912)	X	X	-	-	-	-	-	X
46	<i>H.</i> (<i>Parabellieria</i>) <i>melanura</i> (Meigen, 1826)	X	X	X	X	X	X	X	X
47	<i>Discachaeta arcipes</i> (Pandellé, 1896)	-	-	-	-	-	X	-	-
48	<i>D. pumila</i> (Meigen, 1826)	-	X	X	-	-	X	-	-
49	<i>Heteronychia</i> (s. str.) <i>bulgarica</i> (Enderlein, 1936)	-	-	-	X*	-	-	X	-
50	<i>H.</i> (s. str.) <i>consanguinea</i> (Rondani, 1860)	X	-	-	-	-	-	-	X
51	<i>H.</i> (s. str.) <i>depressifrons</i> (Zetterstedt,).	X	X	-	-	-	-	X	X
52	<i>H.</i> (s. str.) <i>dissimilis</i> (Meigen, 1826)	X	X	X	-	X	X	X	X
53	<i>H.</i> (s. str.) <i>haemorrhoea</i> (Meigen, 1826)	X	X	-	X*	-	-	-	X
54	<i>H.</i> (s. str.) <i>haemorrhoides</i> (Böttcher, 1913)	X	X	X	X	-	X	X	X
55	<i>H.</i> (s. str.) <i>proxima</i> (Rondani, 1860)	X	X	-	X	-	-	X	X

56	<i>H. (s. str.) rohdendorfi</i> (Povolný & Slamečková, 1959)	x	x	-	-	-	-	-	x
57	<i>H. (s. str.) rohdendorfiana</i> Mihályi, 1975	x	x	-	x*	-	-	-	x
58	<i>H. (s. str.) schineri</i> (Bezzi, 1891)	x	x	-	-	-	x	-	x
59	<i>H. (s. str.) slovaca</i> Povolný & Slamečková, 1967	-	x	-	-	-	-	-	-
60	<i>H. (s. str.) vagans</i> (Meigen, 1826)	x	x	x	x	x	x	x	x
61	<i>H. (s. str.) vicina</i> (Macquart, 1835)	x	-	-	-	-	-	x	-
62	<i>H. (Pandelleola) filia</i>	x	-	-	-	-	-	-	-
63	<i>Karovia hirticrus</i> (Pandellé, 1896)	x	x	-	-	-	-	-	x
64	<i>Asceloctella (Mimarhopocnemis) granulata</i> (Kramer, 1908)	x	-	-	-	-	-	-	-
65	<i>Bellieriomima subulata</i> (Pandellé, 1896)	x	x	-	x*	-	-	x	x
66	<i>Krameromyia anaces</i> (Walker, 1849)	x	-	-	-	-	-	-	x
67	<i>Myorhina (Mehria) nemoralis</i> (Kramer, 1908)	x	x	-	-	-	-	-	x
68	<i>M. (s. str.) lunigera</i> (Böttcher, 1914)	x	-	-	-	-	-	-	x
69	<i>M. (s. str.) nigriventris</i> (Meigen, 1826)	x	x	-	-	-	-	-	x
70	<i>M. (s. str.) pandifera</i> (Blackith & Pape, 1999)	x	-	-	-	-	-	-	-
71	<i>M. (s. str.) socrus</i> (Rondani, 1860)	x	-	-	-	-	-	-	-
72	<i>M. (s. str.) soror</i> (Rondani, 1860)	x	x	-	-	-	-	-	x
73	<i>M. (s. str.) villeneuvei</i> (Böttcher, 1912)	x	x	-	-	-	-	-	-

Fauna of Sarcophagidae and Calliphoridae (Diptera) of the West Ukraine

74	<i>Pandelleana protuberans</i> (Pandellé, 1896)	X	X	-	-	-	-	-	-
75	<i>Sarina sexpunctata</i> (Fabricius, 1805)	X	X	-	-	-	-	-	X
76	<i>Thyrsocnema incisilobata</i> (Pandellé, 1896)	X	X	X	X	X	X	X	X
77	<i>T. kentejana</i> (Rohdendorf, 1937)	-	-	-	-	-	-	-	X
78	<i>Bercaea africa</i> (Wiedemann, 1824)	X	X	X	X	X	X	X	X
79	<i>Liopygia (Thomsonea)</i> <i>argyrostoma</i> (Robineau-Desvoidy, 1830)	X	X	-	X*	-	-	-	X
80	<i>L. (Varirosellea) uliginosa</i> (Kramer, 1908)	-	X	-	-	-	-	-	X
81	<i>Liosarcophaga</i> (s. str.) <i>emdeni</i> (Rohdendorf, 1969)	X	X	X	X	X	X	X	X
82	<i>L. (s. str.) harpax</i> (Pandellé, 1896)	X	X	-	-	-	-	-	X
83	<i>L. (s. str.) portschinskyi</i> (Rohdendorf, 1937)	X	X	-	X	-	-	X	X
84	<i>L. (s. str.) tuberosa</i> (Pandellé, 1896)	X	X	-	-	-	-	X	X
85	<i>L. (Pandelleisca) similis</i> (Meade, 1876)	X	X	-	X	X	X	X	X
86	<i>Parasarcophaga</i> (s. str.) <i>albiceps</i> (Meigen, 18926)	X	X	X	X	-	-	X	X
87	<i>Robineauella</i> (s. str.) <i>caerulescens</i> (Zetterstedt, 1838)	X	X	X	X	X	X	X	X
88	<i>Kramerea schuetzei</i> (Kramer, 1909)	-	X	X	X*	-	-	X	X
89	<i>Rosellea aratrix</i> (Pandellé, 1896)	X	X	-	X*	-	-	X	X

90	<i>Sarcophaga bachmayeri</i> (Lehrer, 1978)	-	-	-	-	-	-	-	X
91	<i>S. carnaria</i> (Linnaeus, 1758)	X	X	-	X	X	-	X	X
92	<i>S. disputata</i> Lehrer, 1967	-	-	-	-	-	-	-	X
93	<i>S. hennigi</i> Lehrer, 1978	-	-	-	-	-	-	-	X
94	<i>S. jupalnica</i> Lehrer, 1967	X	X*	-	-	-	-	-	-
95	<i>S. lehmanni</i> Müller, 1922	X	X	X	X	X	X	X	X
96	<i>S. moldavica</i> Rohdendorf, 1937	X	-	-	-	-	-	-	X
97	<i>S. mouchajosefi</i> Lehrer, 1978	-	-	-	-	-	-	-	X
98	<i>S. schusteri</i> Lehrer, 1959	X	-	-	X*	-	-	-	X
99	<i>S. subvicina</i> Rohdendorf, 1937	X	X	X	X	-	-	-	X
100	<i>S. variegata</i> (Scopoli, 1763)	X	X	X	X	X	X	X	X
101	<i>S. zumptiana</i> Lehrer, 1959	-	X	-	-	-	-	-	X
Sarcophagidae		63	62	29	41	17	29	3	80

*Firstly recorded for regional fauna

**Firstly recorded for Ukraine

References

Belke, G. 1859. Esquisse de l'histoire naturelle de Kamienietz-Podolski, précédée d'un coup-d'oeil sur les travaux des Naturalistes des provinces occidentales de la Russie et du Royaume de Pologne au XIX siècle. Bulletin de la Société Impériale des Naturalistes de Moscou 32 (1): 24-106.

Draber-Mońko, Á. 1973. Übersicht der einheimischen Arten der Familie Sarcophagidae (Diptera). Fragmenta Faunistica 19 (9): 157-225.

Grunin, K.Ya. 1970. Fam. Calliphoridae. In: G. Ya. Bey-Bienko (ed.). Key to Insects of European Part of the USSR 5 (2): 607-624. Nauka, Leningrad.

Khanina, I.S. & Khvesik, V.P. 1963. Synanthropic flies of Lutsk city and their sanitary epidemic importance. In: A.P. Markevich (ed.). Problems of Parasitology. Proceedings of 4th Scientific Conference of Parasitologists of Ukrainian SSR: 414-415. Kyiv Taras Shevchenko University Press, Kyiv.

Khitzova, L.N. 1976. On the fauna of sarcophagids (Diptera, Sarcophagidae) of some regions of USSR, 26 pp. Deposited in VINITI 12.10.1976 N 3583-76 Dep., Moscow.

Khrokalo, L.A. & Verves, Yu.G. 2009. Dragonflies (Odonata) and certain two-winged insects (Diptera: Calliphoridae;

- Sarcophagidae) of the Shatsk Lake District. Scientific Bulletin of Volyn National University in Memory of Lesya Ukrainka. 2. Biological sciences: 114-118.
- Logoida, S.S. 1978. Growth spurts in the gypsy moth population in Transcarpathian oak forests and the dynamics of this population in the graded period of 1970-1976. Scientific Reports of High School. Biological Sciences (2): 59-65. Moscow.
- Moskaletz, N.D. 1960. To the knowledge of fauna of synanthropic flies in Uzhgorod of Transcarpathian Region of Ukrainian SSR. Medical Parasitology and Parasitic Diseases 31 (5): 575-578.
- Povolný, D. & Verves, Yu.G. 1986. Revision der palaearktischen Arten der Gattung *Sarcophaga* Meigen, 1826 (Diptera, Sarcophagidae). Acta Entomologica Musei Nationalis Praguae 42: 89-147.
- Povolný, D. & Verves, Yu.G. 1997. The flesh-flies of Central Europe (Insecta, Diptera, Sarcophagidae). Spixiana Suppl. 24: 1-264.
- Rognes, K. 1991. Blowflies (Diptera, Calliphoridae) of Fennoscandia and Denmark. Fauna Entomologica Scandinavica 24: 1-272.
- Rognes, K. 1998. Calliphoridae. In: L. Papp & B. Darvas (eds.). Contributions to a Manual of Palaearctic/European Diptera (with special reference to flies of economic importance). 3. Higher Brachycera: 617-648. Science Herald, Budapest.
- Rognes, K. & Pape, T. 2007. Calliphoridae. Fauna Europaea version 1.1. http://www.faunaeur.org/full_results.php?id=10892. Retrieved 2008-05-31.
- Rohdendorf, B.B. 1970. Fam. Sarcophagidae. In: G. Ya. Bey-Bienko, (ed.). Key to Insects of European Part of the USSR 5 (2): 624-670. Nauka, Leningrad.
- Schumann, H. 1973. Revision der palaearktischen Melinda-Arten (Diptera, Calliphoridae). Deutsche entomologische Zeitschrift (N. F.) 20 (4-5): 293-314.
- Schumann, H. 1974. Revision der palaearktischen Bellardia-Arten (Diptera, Calliphoridae). Deutsche entomologische Zeitschrift (N. F.) 21 (4-5): 231-299.
- Skufyin, K.V. & Khitsova, L.N. 1978. On the Calliphoridae (Diptera) fauna in the European section of the USSR. Vestnik Zoologii 12 (4): 87-89.
- Staněk, M. 1974. The present state of the Jacentkovský collection of subfamily Sarcophaginae (Sarcophagidae, Diptera). Časopis Narodního Muzea 141 (3-4): 176-181.
- Szpila, K. & Yu. Verves, 2008. *Pollenia bulgarica* (Jacentkovský, 1939) – first record from Ukraine, with faunistic notes on other blowflies in the Askania Nova Biosphere Reserve (Diptera, Calliphoridae). Fragmenta Faunistica 51 (2): 143–146.
- Verves, Yu.G. 1973. New species of Sarcophagidae (Diptera) from the Ukraine. Reports of Academy of Sciences of Ukrainian SSR B (10): 946-948.
- Verves, Yu.G. 1974. Sarcophagids (Diptera, Sarcophagidae) of the fauna of USSR. I. Tribe Sarcophagini (Sarcophaginae) (according materials of Institute of zoology of Acad. Sci. UkrSSR). Vestnik Zoologii 8 (1): 30-37.
- Verves, Yu.G. 1975. The new species of the genus *Heteronychia* B. B. (Diptera, Sarcophagidae). Entomologicheskoe Obozrenie 54 (3): 665-667.
- Verves, Yu.G. 1977. Zonal landscape distribution of sarcophagids (Diptera, Sarcophagidae) in the Carpathian Mountains and foothills. Proceedings of Kyiv University, Serie Biology, 19: 78-82.
- Verves, Yu.G. 1978a. Two new genera of Miltogrammatinae (Sarcophagidae, Diptera) from Ukraine and Turkmenia. Reports of

- Academy of Sciences of Ukrainian SSR Series B (7): 638-642.
- Verves, Yu.G. 1978b. Vertical zonal distribution of sarcophagids (Diptera, Sarcophagidae) in Crimea. *Proceedings of Kyiv University, Biology* 20: 93-96.
- Verves, Yu.G. 1979a. Die Sarcophagiden-Fauna (Diptera) der westlich von Dnieper liegenden Gebieten der Ukraine und ihre Herkunft. In: I.M. Kerzhner (ed.). VII. Internationales Symposium über Entomofaunistik in Mitteleuropa. *Verhandlungen*: 340-343. Leningrad.
- Verves, Yu.G. 1979b. Palaearctic species of the subgenus *Spatulapica* Fan of the genus *Heteronychia* B. B. (Diptera, Sarcophagidae). *Zoologicheskii Zhurnal* 58 (6): 860-870.
- Verves, Yu.G. 1982. 64h. Sarcophaginae. In: E. Lindner (ed.). *Die Fliegen der palaearktischen Region* 11 (327): 235-296. Stuttgart.
- Verves, Yu.G. 1984. A check-list of species of Sarcophagidae (Diptera) of the Ukraine and Moldavia. In: O.A. Skarlato (ed.). *Two-winged flies of the fauna of USSR and their significance in ecosystems*: 17-21. Leningrad.
- Verves, Yu.G. 1985a. 64h. Sarcophaginae. In: E. Lindner (ed.). *Die Fliegen der palaearktischen Region* 11 (330): 297-440. Stuttgart.
- Verves, Yu.G. 1985b. Flies from the families Calliphoridae and Sarcophagidae of several regions of Ukraine. *Problems of General and Molecular Biology* 4: 56-60. Kyiv Taras Shevchenko University, Kyiv.
- Verves, Yu.G. 1986. Family Sarcophagidae. In: Á. Soós & L. Papp (eds.). *Catalogue of Palaearctic Diptera* 12. Calliphoridae-Sarcophagidae: 58-193. Academy Press, Budapest.
- Verves, Yu.G. 1989. The zonal landscape distribution of sarcophagids (Diptera, Sarcophagidae) in the Ukraine. In: V.G. Dolin (ed.). *Ecology and Taxonomy of Ukrainian Insects* 3: 158-161. Ukrainian Entomological Society, Kyiv, Odessa.
- Verves, Yu.G. 1990. Prof. Hugo de Souza Lopes and the modern system of Sarcophagidae (Diptera). *Memórias do Instituto Oswaldo Cruz* [1989] 84 (Suppl. 4): 529-545. Manguinhos, Rio de Janeiro.
- Verves, Yu.G. 1993. 64h. Sarcophaginae. In: E. Lindner (ed.). *Die Fliegen der palaearktischen Region* 11 (331): 441-504. Stuttgart.
- Verves, Yu.G. 1994. Sarcophagidae & Calliphoridae in Kyiv - 1. *Oistros* 2: 5-8.
- Verves, Yu.G. 1998. A checklist of species of the Ukrainian Sarcophagidae (Diptera) with a description of a new species. *The Journal of the Ukrainian Entomological Society (Kyiv)* 4 (3-4): 49-57.
- Verves, Yu.G. 2000. Sarcophagidae (Diptera) from Dnipropetrovsk oblast. *Ecology and Biosphaerology* 9 (1-2): 122-126.
- Verves, Yu.G. 2001. Sarcophagidae and Calliphoridae (Diptera) of Chernivtsi oblast. *Scientific Reports of Chernivtsi University*, 126 (Biology): 163-167.
- Verves, Yu.G. 2003. The flies of the families Calliphoridae, Sarcophagidae and Rhinophoridae (Insecta: Diptera) of Botany garden in memory of O. V. Fomin of Kyiv National T. Shevchenko University. *Introduction and Conservation of Plant Diversity* 6: 43-46. Taras Shevchenko University Press, Kyiv.
- Verves, Yu.G. 2004. Records of *Chrysomya albiceps* in the Ukraine. *Medical and Veterinary Entomology* 18: 308-310.
- Verves, Yu.G. 2005. An annotated list of the Ukrainian Calliphoridae (Diptera). *Proceedings of Zoological Museum of the Kyiv Taras Shevchenko National University* 3: 64-121.

- Verves, Yu.G. 2012. The first record of *Bellardia pubicornis* (Diptera, Calliphoridae) from Ukraine. *Vestnik Zoologii* 46 (4): 380.
- Verves, Yu.G. 2013. New record of *Pollenia vera* (Diptera, Calliphoridae) from Ukraine. *Vestnik Zoologii* 47 (1): 94.
- Verves, Yu.G. 2014. The first records of *Sarcophaga hennigi* and *S. schusteri* (Diptera, Sarcophagidae) from Ukraine. *Vestnik Zoologii* 48 (5): 477.
- Verves, Yu.G. & Khrokalo, L.A. 2006. Review of Macronychiinae (Diptera, Sarcophagidae) of the world. *Vestnik Zoologii* 40 (3): 219-239.
- Verves, Yu.G. & Khrokalo, L.A. 2010. The new data on Calliphoridae and Rhinophoridae (Diptera) from Ukraine. *Ukrainska Entomofaunistyka* 1 (1): 23-54.
- Verves, Yu.G. & Khrokalo, L.A. 2014a. An annotated list of the Sarcophagidae (Macronychiinae, Miltogramminae, Eumacronychiinae and Paramacronychiinae) recorded in Ukraine (Diptera). *CESA News* 95: 1-47.
- Verves, Yu.G. & Khrokalo, L.A. 2014b. An annotated list of the Sarcophaginae (Sarcophagidae) recorded in Ukraine (Diptera). *CESA News* 101 (1): 7-81.
- Verves, Yu.G., Korneev V.A. & Vlasov, I.I. 1984. The dipteran of families Platystomatidae, Otitidae, Tephritidae, Syrphidae and Sarcophagidae of Zaporozhye Region. In: V.I. Chopyk (ed.). *Problems of General and Molecular Biology* 3: 86-90. Taras Shevchenko University Press, Kyiv.
- Verves, Yu.G., Kotenko, A.G. & Nikitenko, G.N. 1977. Sarcophagids (Diptera, Sarcophagidae) of the steppe zone of the Ukraine. I. Sarcophagids in the Kherson Region. *Vestnik Zoologii* 11 (3): 62-66.
- Verves, Yu.G., Kurasa V.A., Tanskaya T.F. & Zrazhevskiy, S.F. 1991. The brachycerate two-winged flies of the Zmeinyye Islands of Kanev Reservation. In: V.I. Chopyk (ed.). *Problems of General and Molecular Biology* 3: 86-90. 9: 46-48. Taras Shevchenko University Press, Kyiv.
- Verves, Yu.G. & Kuzmovich, L.G. 1979. Sarcophagine (Diptera, Sarcophagidae), parasites of terrestrial gastropods in the Ternopol Region. *Vestnik Zoologii* 13 (4): 16-21.
- Verves, Yu. & Radchenko, V. 2017. Redescription of male *Sarcophaga disputata* (Diptera: Sarcophagidae) using light and electron microscopy. *Biologia* 72 (1): 76-83.
- Verves, Yu. & Szpila, K. 2008. *Miltogramma drabermankoi* sp. n. from Ukraine (Diptera: Sarcophagidae: Miltogramminae). *Polish Journal of Entomology* 77: 57-61.
- Verves, Yu. & Szpila, K. 2011. *Agriella gavrylenkoi*, a new species of fleshfly from Ukraine (Diptera: Sarcophagidae: Sarcophaginae). *Polish Journal of Entomology* 80: 123-128.
- Verves, Yu.G., Zaigerman, A.G., Kozitskaya A. M. & Korneev, V.A. 1989. Cyclorrhaphous dipteran (Diptera, Cyclorrhapha) of Kanev Pridneprov'e area. In: V. I. Chopyk (ed.), *Problems of General and Molecular Biology* 8: 17-26. Kyiv Taras Shevchenko University, Kyiv.
- Viktorov-Nabokov, O.V. 1959. Fauna and seasonal dynamics of the main species of synanthropic flies of the wood-steppe and western regions of the UkrSSR. In: O. P. Kryshchal (ed.). *Problems of Entomology in Ukraine*: 25-28. Kyiv University Press, Kyiv.
- Xue, W., Verves, Yu. & Du, J. 2011. A review of subtribe Boettcheriscina Verves 1990 (Diptera: Sarcophagidae), with descriptions of a new species and genus from China. *Annales de la Société Entomologique de France* (N. S.) 47 (3-4): 303-329.

Observations on underwater oviposition in *Pseudagrion indicum* Fraser (Odonata:Coenagrionidae): an endemic species from the Western Ghats

*Neha Mujumdar¹, Dipti Thakuria², Dheeraj Halali³ and Pankaj Koparde⁴

¹Bombay Natural History Society, Shaheed Bhagat Singh Road, Colaba, Mumbai - 400001, Maharashtra, India.

²Gauhati University, Gopinath Bordoloi Nagar, Jalukbari, Guwahati - 781014, Assam, India.

³Department of Zoology, Parvatibai Chowgule College of Arts & Science, Gogol, Margao 403602, Goa, India.

⁴Indian Institute of Science Education and Research, Mangalam, Tirupati - 517507, Andhra Pradesh, India.

(Email: nehadm02@gmail.com)

Abstract

Underwater oviposition of the Western Ghats endemic *Pseudagrion indicum* Fraser is discussed as a part of the reproductive behavior of odonates in the present article. Opportunistic records from two localities in Northern and Southern Western Ghats highlight the lack of data on breeding biology of these odonates. Observations presented here throw light on the need for documentation of breeding season of these species, which appears to be the post-monsoon season for *P. indicum*. Our work concludes that more emphasis should be given on ecological studies of these insects, especially endemic species that can provide valuable inputs in designing conservation strategies for potential areas.

Keywords: *Pseudagrion indicum*, oviposition, behavior, Western Ghats, endemic.

Received: 24 November 2017; Revised: 2 May 2018; Online: 30 May 2018.

Introduction

Oviposition, which is the culmination of habitat selection in odonates, is of various forms. Endophytic oviposition is a specialized type of behavior of odonates (Corbet, 1962), typically shown by damselflies and some members of family Ashneidae (Anisoptera). Damselflies have elaborate, serrated ovipositor adapted for making incisions in the tissues of plants and placing the eggs in them (Subramanian, 2009). Most of the dragonflies show exophytic oviposition wherein female lays eggs directly over water either by dipping the abdomen in flight or by perching on rocks or logs (Nair, 2011).

Pseudagrion indicum Fraser

Pseudagrion indicum Fraser, 1924 belonging to family Coenagrionidae, commonly known as Yellow-striped Blue Dart, is an endemic species to the Western Ghats of India. It usually breeds

in marshes associated with hill streams (Subramanian, 2009) and streams in closed canopy forests (Koparde *et al.*, 2015). According to Varghese *et al.* (2014), this species is abundant in Thattekkaddu Bird Sanctuary, Kerala. It has been categorized as a Data Deficient species by IUCN Red List of Threatened Species (Dow, 2009). The information available on the breeding biology of the species is still lacking.

Materials and Methods

Study area

Opportunistic observations on underwater oviposition of *P. indicum* were recorded at two different localities– 1) Perennial stream at Urulanthanni, Kerala and 2) Sanguem river, Sanguem, Goa. Urulanthanni is situated in Thattekkaddu area which is famous for its low land forests and avifaunal diversity. This area

forms a part of Salim Ali Bird Sanctuary which mostly comprises of mixed vegetation like tropical evergreen and semi-evergreen forests, tropical moist deciduous forest, plantations and patches of grassland and riparian vegetation. This area receives 400cm rainfall on an average annually (Varghese *et al.*, 2014).

Sanguem or Salaulim River is a tributary of Zuari River present in southern part of Goa. This study site is close to human habitation, where the river is flanked with coconut plantations. Annual rainfall recorded all over the state is 300-400cm (Rangnekar *et al.*, 2010).

Observations

1) Perennial stream at Urulanthanni, Kerala

During the second National DragonflyIndia Meet at Thattekkaddu Bird Sanctuary, we observed the egg-laying behavior of *P. indicum*. As a part of exploratory surveys conducted during the meet, we observed the oviposition behavior at one of the streams at Urulanthanni (10°7'41.07"N, 76°45'19.08"E, 62m a.s.l.) at 11:30 hrs on 13 September 2015. The stream we visited was perennial with a varying width in the range of 10-25m and about a foot deep at the site of the observation with no canopy cover. The water-flow was moderate enough for us to stand and observe the oviposition activities without much disturbance. We observed, identified and photographed a pair of *P. indicum* which was initially in tandem. The female began to oviposit immediately after copulation. Initially, the abdomen of the female was partially submerged underwater and later she started descending underwater. The female was laying eggs inside the plant tissue (endophytic oviposition), as apparent from the movement of the abdomen. The male, on the other hand, was hovering above, in front of the female with his abdomen slightly curved downward, occasionally perching on vegetation around (non-contact guarding) (Figure 1). We observed that the female was 1-2 centimeters under the water surface. We timed our observation when the female went underwater and noticed that she remained underwater for at least 16 minutes (11:28 to 11:44 hrs). The presence of many observers interrupted the guarding by the male for a while, hence we left the site.

2) Sanguem River, Goa

While surveying the river for odonates, in total five observations on underwater oviposition were recorded from 3rd to 9th December 2015. All observations were recorded between 11:00 to 14:00 hrs on a transect (50m length and 20m width) along river with submerged aquatic vegetation (15°13'48"N, 74°10'12"E, 21m a.s.l.). There was no canopy cover at the site of observation and the flow of water was moderate. Although the time spent by the female under the water could not be timed, other interesting observations about the pairs in tandem were noted down.

Males clasped the female prothorax in flight and tandem was formed in air. Upon formation of the tandem, male and female descended down to suitable perch for mating wheel formation. In the tandem, male guided female to the oviposition site which basically consisted of submerged vegetation with small part of the plant above the water surface in the middle of the river for initiating oviposition (Figure 2). On few of the occasions, rival males of *P. indicum* and also other sympatric species like *Pseudagrion microcephalum* (Rambur, 1842) and *Pseudagrion rubriceps* (Selys, 1876) were seen attacking the mating pair. Physical impacts on the lateral side of female's thorax and the lower abdomen of the clasping male by rivals were considered as attempts to break the tandem.

In case of rigorous aggression, tandem continuously shifted its position or moved to the bank of river and headed back to the water after some time to resume oviposition. After finding a suitable oviposition site, they perched on aquatic vegetation just above the water surface. The female slowly started descending under water while still in tandem exhibiting contact guarding by the male. Male held the female till his abdomen was completely submerged and water level was up to the thorax. Then the male released female which then continued descending further into water to lay eggs. On one occasion, the male accompanied female under water for some time where it was submerged entirely (Figure 3). After few minutes, it emerged to the surface and female continued descending (Figure 4 and 5). Similar observations were also made for sympatric

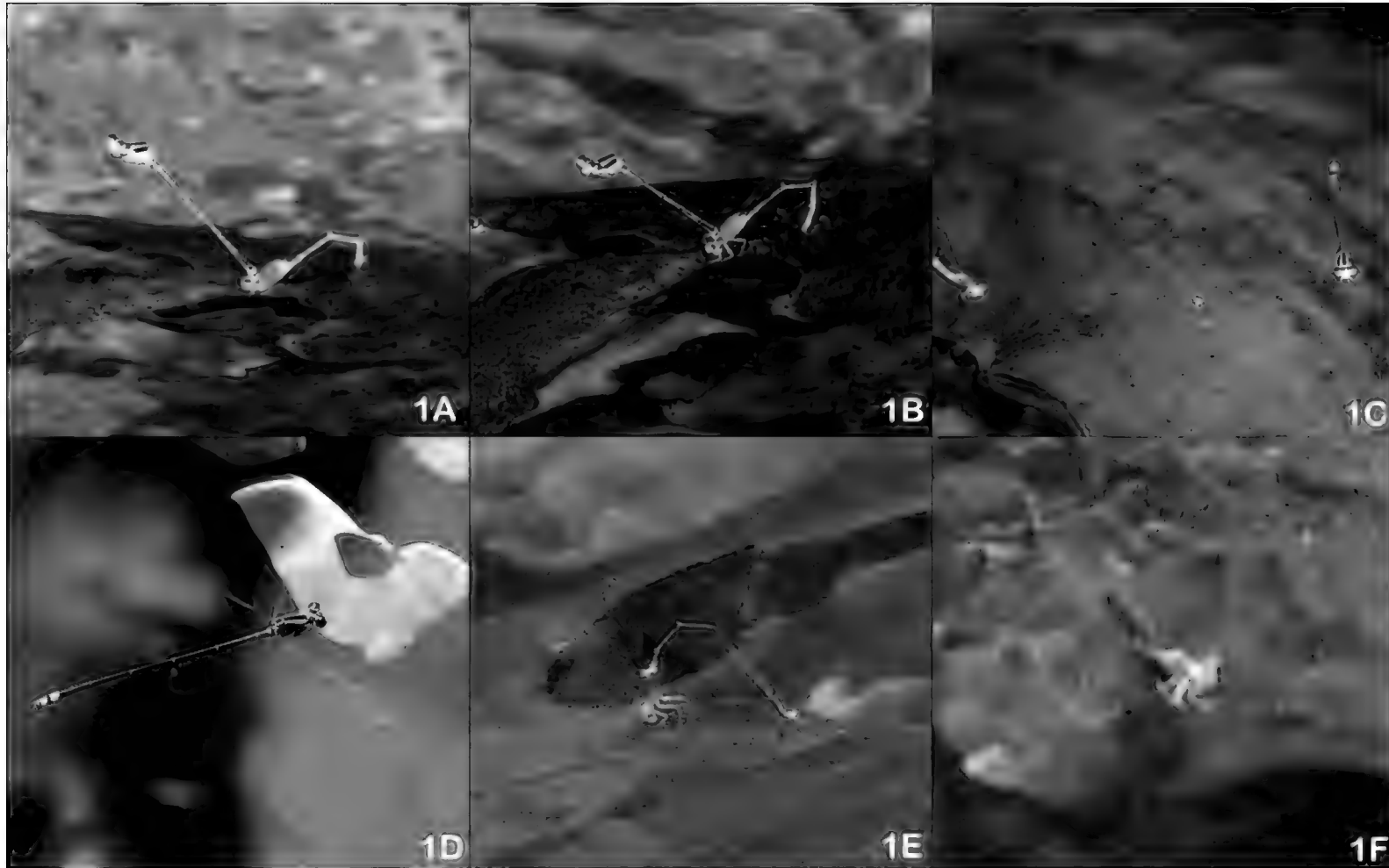
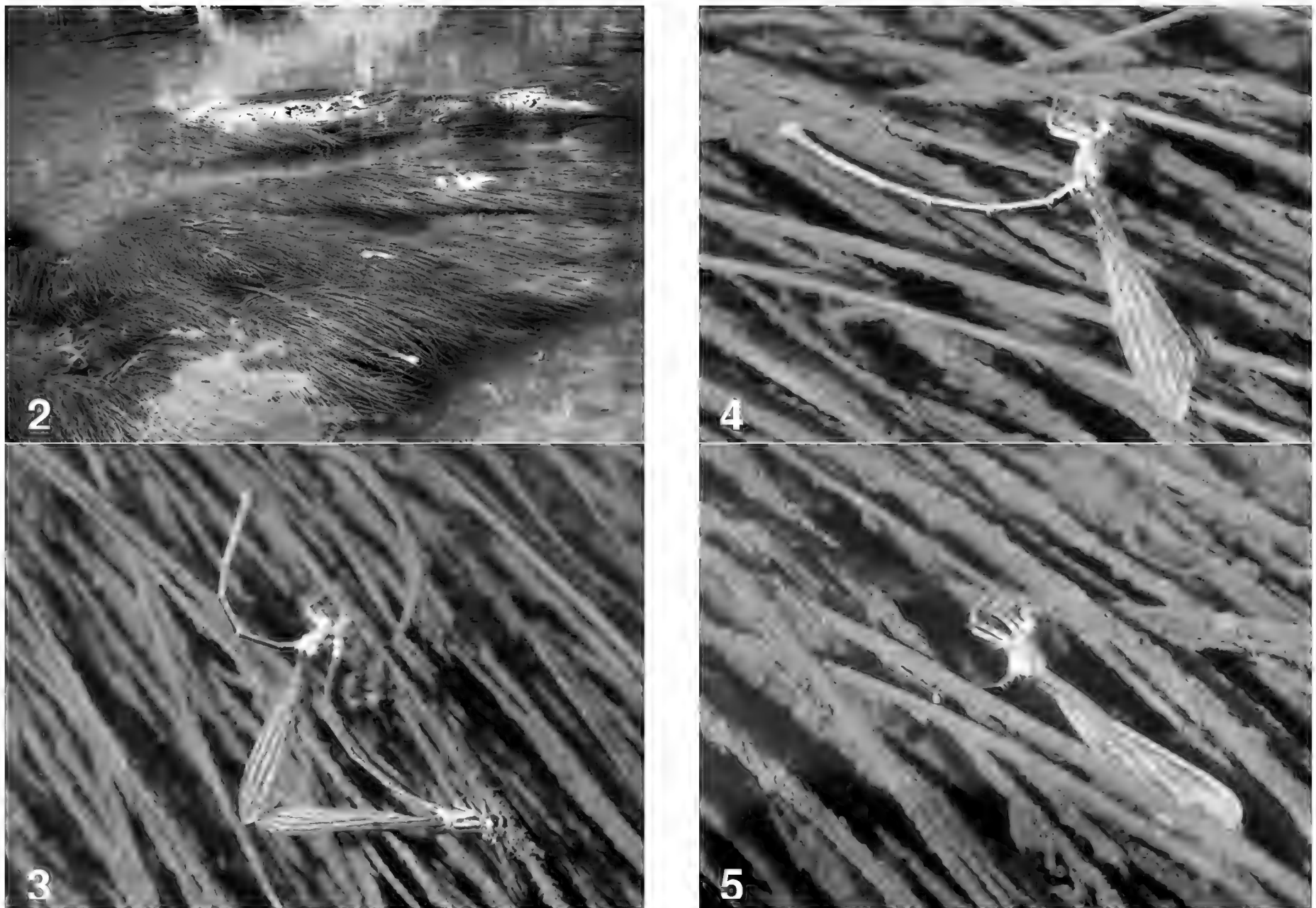


Figure 1. Sequence of probable egg laying in observed pair of *P. indicum*. Figures 1A-C and 1F by Pankaj Koparde. Figure 1D by Prosenjit Dawn and 1E by Kalavanti Mokaria.



Figures 2-5: 2. Submerged vegetation used for oviposition at Sanguem river, Goa; 3. Male of *P. indicum* under water with female during oviposition; 4. Female of *P. indicum* ovipositing without male; 5. Female descending further down for oviposition without male. Figs. by Dheeraj Halali

species *Pseudagrion microcephalum* (Rambur, 1842).

Results

We identified the plant on which the female oviposited at Urulanthanni as Dark Lettuce, *Ottelia alismoides* (L.) Pers. (Nayar *et al.*, 2006; The Plant List 2013). It was about two to five meters away from the shore. The leaf on which the female was ovipositing, was almost submerged leaving only some portion near its tip above the water surface. It is worth to note that this observation was only one instance of mating though we saw multiple individuals of *P. indicum* in a walk of around 1km. We could observe the reproductive and mate-guarding behavior of *P. indicum* pair only for 16 minutes. Hence, we do not know whether the female was alive and emerged out of water successfully later on. Other zygopterans present nearby the site included a male individual each of *Heliocypha bisignata* Hagen in Selys, 1853 and *Neurobasis chinensis* (Linnaeus, 1758). On the other hand, the plant used for oviposition at Sanguem was not identified. Also, we don't know if the female emerged alive to the surface after the completion of oviposition. Other odonates sighted nearby were *Pseudagrion microcephalum* Rambur, 1842, *Pseudagrion rubriceps* Selys, 1876, *Pseudagrion decorum* Rambur, 1842 and *Libellago lineata* Burmeister, 1839.

There is no information available on the breeding season of *P. indicum*. In order to understand the possible breeding season of the species, we mined information from few citizen science projects such as Dragonflies of India(<http://indiabiodiversity.org/group/dragonflies_of_india/show>), Odonata of India (Anonymous 2018) and DragonflyIndia (<<https://www.facebook.com/groups/dragonflyindia/>>). We found 37 observations, of which five observations were reproduction related. Of the five observations, three were taken in April, one in May and one in September in Kerala (South Western Ghats). Apart from these, there are observations in September and December (Pankaj Koparde Pers. Comm.) from Maharashtra (North Western Ghats).

Discussion

According to Corbet (2004), underwater oviposition is dominant in certain species of *Calopteryx* Leach, 1815, *Coenagrion* Kirby, 1890, *Enallagma* Charpentier, 1840 while infrequent in some genera e.g *Anax* Leach, 1815, *Chlorocypha* Fraser, 1928 and *Ischnura* Charpentier, 1840. During underwater oviposition, it is normal for the male to guard and wait for the submerged female, but in the genus *Pseudagrion* Selys, 1876, the male sometimes submerges completely while accompanying the submerged female (Furtado, 1972). The male of *P. microcephalum* may accompany the female in tandem, beneath the water; but then separates after two minutes, floating to the surface and then resting on the nearest perch; but the male of *P. perfuscatum* Lieftinck, 1937 may submerge for 15 minutes and hover above the female while she descends beneath the water surface (Furtado, 1972). Babu (1986) reported that the female of *P. decorum* (Rambur, 1842) showed oviposition behavior in two forms - oviposition above water surface which was accomplished in tandem with the male and underwater oviposition by female alone while the male maintained a guard at the site. The oviposition in tandem was brief (One and a half minutes), whereas the underwater oviposition lasted for 14-27 minutes. Underwater egg-laying forms the main oviposition behavior in *P. decorum*.

Various hypotheses have been proposed for such behavior. A habitat must meet the ecological needs of all the stages of life cycle from egg to adult. Selection of suitable sites by female affects the survival of eggs directly as they are exposed to various biotic and abiotic factors. According to Corbet (1962), various factors might be influencing this behavior such as selecting securely rooted vegetation and thereby reducing chances of eggs not getting swept downstream, getting respite from interference of other males, and avoiding desiccation in case of seasonal fluctuation in water level.

As stated in Corbet (2004) by Fincke (1988), a convincing interpretation of the functional significance of post copulatory behavior helps us to understand about some

other taxa which lack post-copulatory guarding behavior and exhibit sperm competition and female mortality due to predation. Post-copulatory guarding has manifold effects for the taxa for lessening sperm competition. By failing to guard after copulation a male *Enallagma hageni* entails a 38% risk of losing potential fertilization to other males via sperm displacement, or 3% risk of death of his mate before she has laid all her current clutch.

Odonates are very good indicators of riparian and wetland ecosystems. Most of the endemic odonates of Western Ghats are habitat specialists (Subramanian *et al.*, 2008; Babu *et al.*, 2013; Koparde *et al.*, 2014; Kulkarni and Subramanian, 2013) and therefore, highly sensitive to changes in their habitat. Lack of proper data on their reproductive biology in conjugation with loss of habitats poses a serious threat to their survival that might lead to species extinction. Our current observation in September from Southern Western Ghats and Goa is suggestive of possible lack of data on the species breeding season. From the compilation of the observations, it seems that the species breeds during pre-monsoon (March-May) and post-monsoon (October-February) seasons. In the light of this, the grave and accelerating destruction of habitats may pose serious threat to the odonates. Therefore, an opportunistic observation like the one reported here are worth recording and it strongly highlights the need for focused studies on odonate ecology. Such information provides the basis from which principles of conservation management can be inferred.

Acknowledgments

We are grateful to David Raju for his guidance throughout the observation and sharing duration of the observation with us at Kerala. We would like to thank the participants Kalavanti Mokaria and Prosenjit Dawn for providing images. We would like to acknowledge Rajdeo Singh from Bombay Natural History Society for helping in plant identification. NM would like to express sincere gratitude towards Bombay Natural History Society for financial support to attend the meet. DT would like to express heartfelt thanks to her guide Professor Jatin Kalita,

Gauhati University for his continuous support and guidance throughout research work and encouraging to attend the meet. We are grateful to the organizers of the Dragonfly India meet 2015, Kerala Forests and Wildlife Department, Kottayam Nature Society and Diversity India.

References

- Anonymous. 2018. *Pseudagrion indicum* Fraser, 1924 – Yellow-striped Dart. In: Joshi, S., P. Koparde, P. Dawn, P. Roy and K. Kunte (eds.). *Odonata of India*, v. 1.10. Indian Foundation for Butterflies. Accessed online at <http://www.indianodonata.org/sp/392/Pseudagrion-indicum> on 19 April 2018
- Babu, B.S. 1986. Ecological studies on Odonata larvae and their role in the biological control. Ph.D. Dissertation. Doctor Harisingh Gour Vishwavidyalaya Sagar (M.P) India. 161 pp.
- Babu, R., Subramanian, K.A. and Nandy, S. 2013. Endemic odonates of India. Records of the Zoological Survey of India. 347: 1–60.
- Corbet, P.S. 1962. Biology of Dragonflies. H. F. & G. Witherby Ltd. 12 pp.
- Corbet, P.S. 2004. Dragonflies Behavior and Ecology of Odonata (Revised Edition). Habitat selection and oviposition. Colchester, UK: Harley Books. Pp. 9 – 43,427–558.
- Dow, R.A. 2009. *Pseudagrion indicum*. The IUCN Red List of Threatened Species 2009:e.T163676A 5634305. Downloaded on 21 November 2017. Accessed online at <http://dx.doi.org/10.2305/IUCN.UK.2009-2.RLTS.T163676A5634305.en>.
- Furtado, J.I. 1972. The reproductive behavior of *Ischnura senegalensis* (Rambur), *Pseudagrion microcephalum* (Rambur) and *P. perfuscatum* Lieftinck (Odonata, Coenagrionidae). Malaysian Journal of Science 1: 57-69.
- Kulkarni, A.S. and Subramanian, K.A. 2013. Habitat and seasonal distribution of Odonata (Insecta) of Mula and Mutha river basins, Maharashtra, India. Journal of Threatened Taxa 5: 4084 - 4095

- Koparde, P., Mhaske, P. and Patwardhan, A. 2014. New records of dragonflies and damselflies (Insecta: Odonata) from the Western Ghats of Maharashtra, India. *Journal of Threatened Taxa* 6: 5744–5754
- Koparde P., Mhaske, P. and Patwardhan, A. 2015. Habitat correlates of Odonata species diversity in north Western Ghats, India. *Odonatologica* 44 (1/2): 21–43
- Nair, M.V. 2011. Dragonflies and Damselflies of Orissa and Eastern India, Wildlife Organisation, Forest & Environment Department, Government of Orissa. 22 pp.
- Nayar, T.S., Rasiya Beegam, A., Mohanan, N. & Rajkumar, G. 2006. Flowering Plants of Kerala – A Handbook. Tropical Botanic Garden and Research Institute, Thiruvananthapuram. pp. 710-711.
- Rangnekar, P., Borkar, M. and Dharwadkar, O. 2010. Additions to the Odonata (Insecta) of Goa. *Journal of Threatened Taxa* 2(4): 805-814.
- Subramanian, K.A., Ali, S. and Ramchandra, T.V. 2008. Odonata as indicators of riparian ecosystem health a case study from south western Karnataka, India. *Fraseria (NS)* 7:83–95
- Subramanian, K.A. 2009. Dragonflies and damselflies of peninsular India—a field guide. In: M. Gadgil (ed.), *Project lifescape series*. Vigyan Prasara. New Delhi. Pp. 4, 5, 104.
- The Plant List. 2013. Version 1.1. Accessed online at <http://www.theplantlist.org/tpl1.1/search?q=ottelia+alismoides> on 22nd November 2017
- Varghese, A.P., Nikesh, P.R. and Mathew, J. 2014. Odonata (Insecta) diversity of Salim Ali bird Sanctuary and its adjacent areas in Thattekkad, Kerala, India. *Journal of Threatened Taxa* 6(6): 5887–5893.

Description of dealate of *Myrmecina urbanii* Tiwari (Hymenoptera: Formicidae) from Karnataka, India, with notes on worker castes

Thresiamma Varghese

Centre for Ecological Sciences, Indian Institute of Science, Bangalore 560 012, India.

(Email: thresiammav@iisc.ac.in)

Abstract

The dealate of the myrmicine ant, *Myrmecina urbanii*, is described. The genus *Myrmecina* is known to show queen polymorphism, wherein wingless “intermorphs” which are morphologically intermediate between gynomorphs and worker castes are known to occur and lay eggs. *M. urbanii* is known from worker castes only. In the present study, few workers, which are intermediate between queen and worker castes, are also observed. Based on the external morphology and morphometric measurements, variations across the worker castes are also discussed in this study. The workers exhibited considerable variations, especially in the pattern of striations on their thorax and in their body size. The morphometric study of workers implies the presence of intercastes in this species, even though the ovarian status of none of the workers was examined.

Keywords: *Myrmecina*, dealate, worker, morphometry, intercastes.

Received: 6 February 2018; Revised: 4 May 2018; Online: 30 May 2018.

Introduction

The genus *Myrmecina*, contains 53 extant species and one subspecies (<http://www.antweb.org>, dated 06/02/18). This leaf-litter ant is distributed throughout the Europe, northern Africa, from southern Canada to southern Mexico, India, Sri Lanka, Korea, Japan, Fiji, the Solomon Islands and Australia (Shattuck, 2009; Wong & Guenard, 2016).

Tiwari (1994) described two species of this genus, *M. urbanii*, and *M. vidyae* from Kerala, India, based on the worker caste. Later, Sunil *et al.* (1997), Varghese (2004), Narendra and Kumar (2006) reported the genus *Myrmecina* from Karnataka, again based on the worker caste. Saranya *et al.* (2013) reported *M. striata* from Periyar Tiger Reserve in South Western Ghats. Parui *et al.* (2015) reported *M. urbanii* from Orissa. A recent update of the ants of India by Bharti *et al.* (2016) reported 4 species of *Myrmecina* from India.

Even though the biology and colony structure of this genus are poorly understood, the following studies have investigated these areas: Kutter (1916), Ohkawara *et al.* (1993), Buschinger (2001, 2003, 2005), Murakami *et*

al. (2002), Huang *et al.* (2008) and Zhou *et al.* (2008).

Tsuji *et al.* (2001) reported unicoloniality in *Myrmecina* species from Indonesia. Buschinger and Schreiber (2002) have described queen polymorphism in *M. graminicola* (Latreille) and Buschinger *et al.* (2003) reviewed the geographic distribution of queen polymorphism in *M. graminicola* (Latreille). The phylogeny and evolutionary history of queen polymorphism in the genus *Myrmecina* was studied by Steiner *et al.* (2006). Miyazaki *et al.* (2010) looked at the ergatoid queen development in *M. nipponica* Wheeler.

Studies by Plateaux (1970) showed that the dimensions of head, thorax and gaster of intercastes increased independently of one another in *Leptothorax nylanderii* (Forster). In the ant family Formicidae, the presence of intercastes and their occurrence was reported by Ohkawara *et al.* (1993); Düsselmann *et al.* (1996); Kikuchi *et al.* (1999) and Molet *et al.* (2009; 2012). Few earlier studies have focused on the characteristics of intercastes in ants (Buschinger & Winter, 1975; Francoeur *et al.*, 1985; Peeters,

1991, 2012). The morphological variability of intercastes in *T. nylanderi* was studied by Okada *et al.* (2013).

In this study, the dealate of *Myrmecina urbanii* is described and notes on worker castes are provided. Even though, *M. urbanii* has appeared in distribution records and checklists, neither its different castes nor its biology is studied. Recently, while studying the ant fauna of the Indian Institute of Science campus, the present author has come across 2 dealates and few individuals belonging to the worker castes of *M. urbanii*, and perhaps some intermediate forms also. Since the reproductive caste of this species is not presently known, it is described here, along with morphometric measurements of worker castes and discussed the morphological variations within the worker castes. Based on the results of this study, presence of intercastes in *M. urbanii* is suggested here.

Materials and Methods

All observations and measurements were taken using a WILD Stereo Zoom microscope. All specimens of *M. urbanii* were obtained from Winkler samples. Voucher specimens are deposited in the Insect Museum at the Centre for Ecological Sciences, Indian Institute of Science, Bangalore. The images of *M. urbanii* were taken by the SEM facility at SSCU, Indian Institute of Science.

The linear measurements and indices employed in this study are described below:

HL	Head length: Length of head from the posterior margin of the head to the anterior extremity of the clypeus
HW	Head width: Maximum width of head, including the eyes
EL	Eye length: Length of compound eye measured in the same view as HL
SL	Scape length: Length of the first antennal segment, excluding the radicle
ANTML	Antennomere length: Total length of funiculus
MSL	Mesosoma length: Maximum measurable length of mesosoma in dorsal view
MSW	Mesosoma width: Maximum measurable width of mesosoma in dorsal view
PTL	Petiole length: Maximum length of

	petiole, measured in dorsal view
PTW	Petiole width: Maximum width of petiole, measured in dorsal view
PTH	Petiole height: Maximum height of petiole, measured in profile
PPTL	Postpetiole length: Maximum length of postpetiole measured in dorsal view
PPTW	Postpetiole width: Maximum width of postpetiole measured in dorsal view
PPTH	Postpetiole height: Maximum height of postpetiole measured in profile
GL	Gaster length: Maximum length of gaster measured in dorsal view
GW	Gaster width: Maximum width of gaster measured in dorsal view
GH	Gaster height: Maximum height of gaster measured in profile
TL	Total length: Maximum measurable length in profile.
CI	Cephalic index: $HW/HL \times 100$
SI	Scape index: $SL/HL \times 100$
PTLI	Petiole length index: $PTH/PTL \times 100$
PTWI	Petiole width index: $PTW/PTL \times 100$
PPTLI	Postpetiole length index: $PPTH/PPTL \times 100$
PPTWI	Postpetiole width index: $PPTW/PPTL \times 100$
GLI	Gaster length index: $GL/HL \times 100$

Genus *Myrmecina* Curtis

Myrmecina Curtis, 1829, 6: 242 - 288: Type-species: *Myrmecina latreillii* (Junior synonym of *Formica graminicola* Latreille 1802), by monotypy.

Worker Diagnosis: Head with sharp longitudinal carinae on vertex and lateral margin of head; antennae 12 segmented with a well-formed 3 segmented club; antennal scrobes absent; petiole sessile and longer than broad with subpetiolar process; propodeum armed with long and curved spines.

Myrmecina urbanii Tiwari, 1994

Myrmecina urbanii Tiwari, 1994, 94 (2 - 4): 151 - 158 (ZSI)

Worker Diagnosis: As specified by Tiwari (1994), *M. urbanii* workers are characterized by deep striations on head, mesosoma and petiole, with a characteristic “Y” appearance on thorax.

Other characters are: antennae 12 segmented with 3 segmented club; basal funicular segments broader than long, apical 3 segments much longer than other segments. Small teeth on antero-lateral corners of pronotum and metanotum; propodeal spines long, thick and curved upwards; petiole longer than broad with a distinct subpetiolar process.

Dealate: (Plate 1, Figs. 1 – 4; Table 1) Head slightly broader than long (CI 104) with lateral margin almost straight, posterior corners rounded and broadly emarginated at middle; mandibles large and convex, masticatory margin with 10 blunt and broadly worn teeth spaced at regular intervals; palp formula 3:2; clypeus narrow, broadly concave in the middle and more or less transverse apically with ridges or carinae laterally; frontal area not well differentiated, frontal lobes partially covering the antennal sockets, antennal scrobes absent; antennae with 12 segments, with 3 segmented club; scape long, slightly curved in the middle, funicular segments 1 - 8 broader than long, 9 - 11 longer than broad, the apical segments longer than the preceding 2 segments put together; eyes small, (larger compared to that of workers, EL 0.04mm in workers), convex and projects partially outside the margin of head; eyes surrounded by a pale area and located laterally below the mid-length of the head; ocelli present on vertex; mesosoma broad, gibbous, not wider than head, much wider and longer than that in worker, pronotum broader than long, humeral angles rounded, pro-meso and meso-metanotal sutures distinct dorsally and laterally, metanotum distinct, slightly produced backwards, rounded posteriorly, propodeum armed with a pair of long, stout spines, directed backwards; petiole sessile, first node as long as broad, flat dorsally with almost straight lateral margins, postpetiole as long as the first node, 1.28x broader than long, rounded dorsally and laterally with a well formed subpetiolar process; legs short and thick; gaster broadly oval, 1.17x longer than broad, first tergite comprises $\frac{3}{4}$ th gaster length, lateral angle of first gastral tergite projects forward; dorsum more or less rounded.

Head, thorax and postpetiole coarsely striated, dorsum of petiole finely striated, head

and thorax longitudinally striated, while pronotum transversely striated, the striations on thorax do not converge in a “Y” shape as in workers (in workers, striations on thorax are transverse) mandibles, clypeus and gaster smooth.

Pilosity long, abundant, with a few long and straight setae at the anterior margin of clypeus, pubescence moderate.

Head, part of thorax and gaster dark ferruginous, mesonotum and petiole little lighter shade, mandibles, clypeus, antennae, tip of the first gastral tergite and the remaining tergites reddish yellow and legs paler.

Measurements: TL 4.40, HW 1.00, HL 0.96, EL 0.10, SL 0.76, ANTML 1.20, MSL 1.16, MSW 0.80, PTL 0.28, PTW 0.28, PTH 0.28, PPTL 0.28, PPTW 0.36, PPTH 0.32, GL 1.44, GW 1.12, GH 0.80, CI 104, SI 76, PTLI 100, PTWI 100, PPTLI 114, PPTWI 128, GLI 144.

Materials Examined: 2 dealates; INDIA: Karnataka: Bangalore (13° 01'N 77° 34'E): Malleswaram: Indian Institute of Science Campus: 21.xii.2009, Coll. Thresiamma Varghese, Centre for Ecological Sciences (Collected by Winkler method) (One specimen prepared for SEM studies is not included in the morphometry studies).

Details of worker castes examined: 3 Workers: Same data as dealates: INDIA: Karnataka: Bangalore (13° 01'N 77° 34'E): Malleswaram: Indian Institute of Science Campus: 4.xii.2009, Coll. Thresiamma Varghese. 4 workers, same locality, except the date of collection, 21.xii.2009.

Notes on worker castes (Plate 2. Figs. 1-5; Plate 3. Figs. 1-6)

The description of *M. urbanii* Tiwari, 1994 was based on two worker specimens, whose body lengths were 3.20mm, 3.40mm, with a head width of 0.73 and 0.75mm respectively. The present study shows that the total length of worker specimens varied from 2.96 - 4.20mm, with a head width of 0.72 - 1.00mm (N = 7). The morphometric values of these workers are provided in Table 1.

Table 1. The morphometric values of the dealate and the workers of *M. urbanii*

Parameters	Dealate	W*1	W2	W3	W4	W5	W6	W7
TL	4.40	3.60	3.52	3.56	3.04	2.96	3.80	4.20
HL	0.96	0.80	0.84	0.84	0.76	0.72	0.88	1.00
HW	1.00	0.80	0.80	0.80	0.76	0.72	0.92	1.00
EL	0.10	0.04	0.04	0.04	0.04	0.04	0.04	0.04
SL	0.76	0.72	0.76	0.80	0.68	0.64	0.76	0.80
ANTML	1.20	0.92	0.96	0.92	0.92	0.80	1.00	1.00
MSL	1.16	0.84	0.88	0.92	0.88	0.76	0.96	1.00
MSW	0.80	0.60	0.64	0.60	0.52	0.52	0.64	0.68
PTL	0.28	0.28	0.28	0.28	0.24	0.20	0.28	0.28
PTW	0.28	0.20	0.24	0.24	0.20	0.20	0.24	0.32
PTH	0.28	0.20	0.20	0.20	0.20	0.20	0.24	0.28
PPTL	0.28	0.24	0.24	0.24	0.20	0.20	0.24	0.28
PPTW	0.36	0.28	0.28	0.28	0.28	0.24	0.32	0.36
PPTH	0.32	0.24	0.28	0.28	0.28	0.24	0.28	0.32
GL	1.44	1.12	1.12	1.20	1.12	0.96	1.24	1.36
GW	1.12	0.84	0.88	0.88	0.84	0.88	0.92	1.08
GH	0.80	0.68	0.68	0.72	0.60	0.56	0.72	0.80
CI	104	100	95	95	100	100	104	100
SI	76	90	95	100	89	88	82	80
PTL1	100	71	71	71	83	100	85	100
PTWI	100	71	85	85	83	100	85	114
PPTLI	114	100	116	116	140	120	116	114
PPTWI	128	116	116	116	140	120	133	128
GLI	144	140	140	150	147	133	134	136

*Note: W1 - W7 (Workers 1 – 7) (All values are in millimeters)

Plate 1

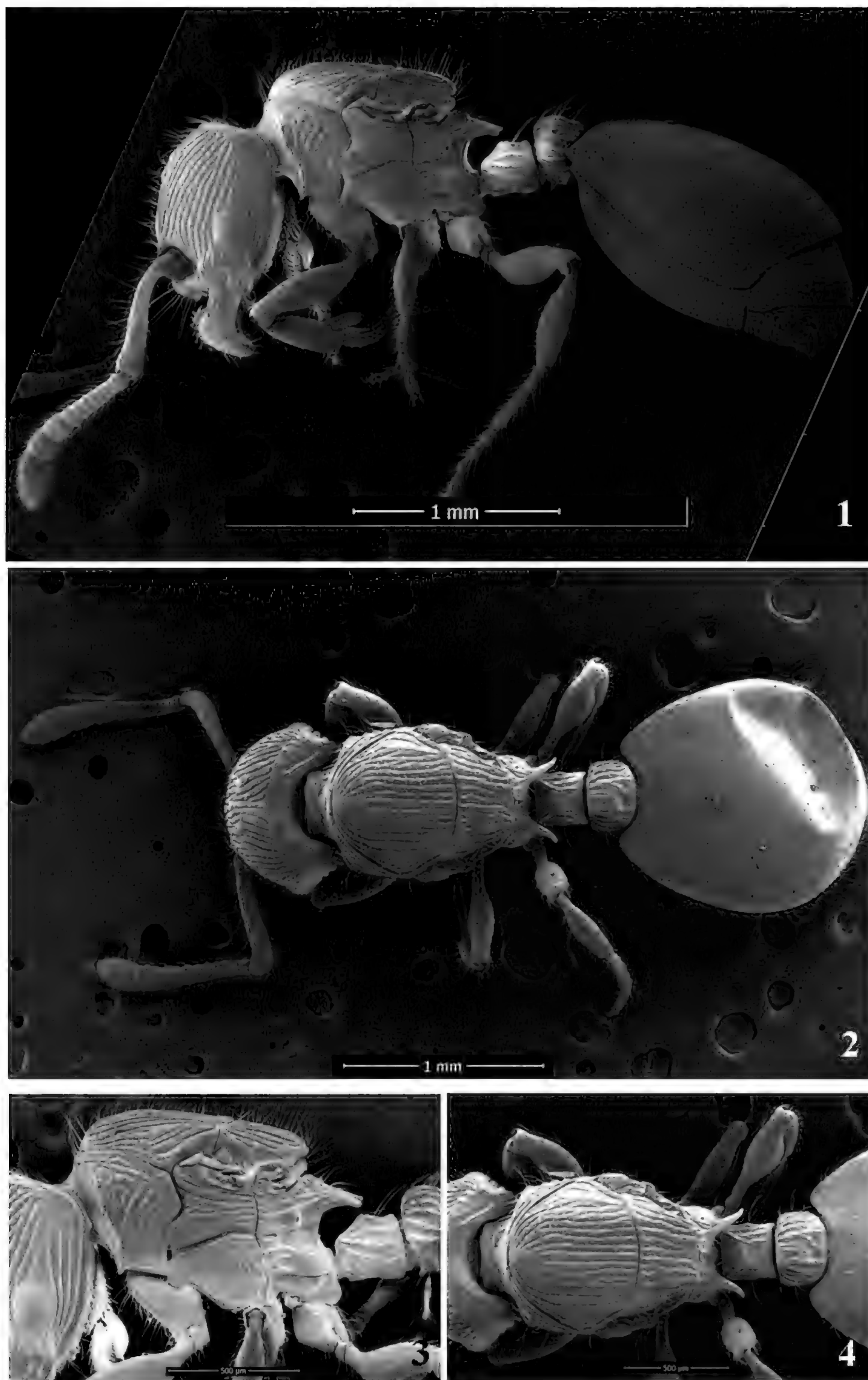


Plate 1. Figures 1-4. *M. urbanii*, dealate: 1. Profile of *M. urbanii*; 2. Dorsal view of *M. urbanii*; 3. & 4. Mesosoma, profile and dorsal view of *M. urbanii*.

Plate 2

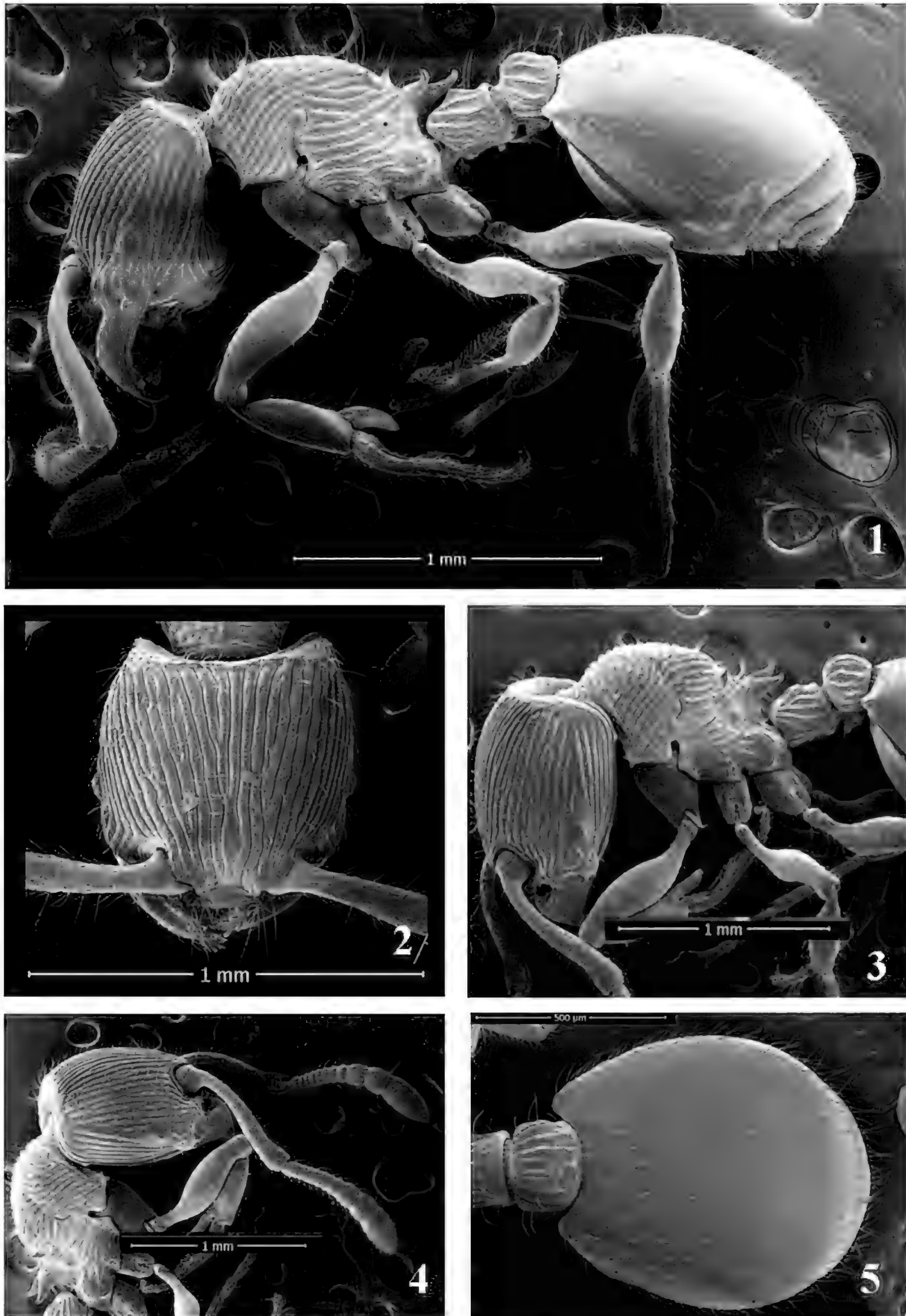


Plate 2. Figures 1–5. *M. urbanii* worker caste: 1. Profile of *M. urbanii*; 2. Head, frontal view; 3. Mesosoma, profile; 4. Antennae; 5. Gaster, dorsal view.

Plate 3

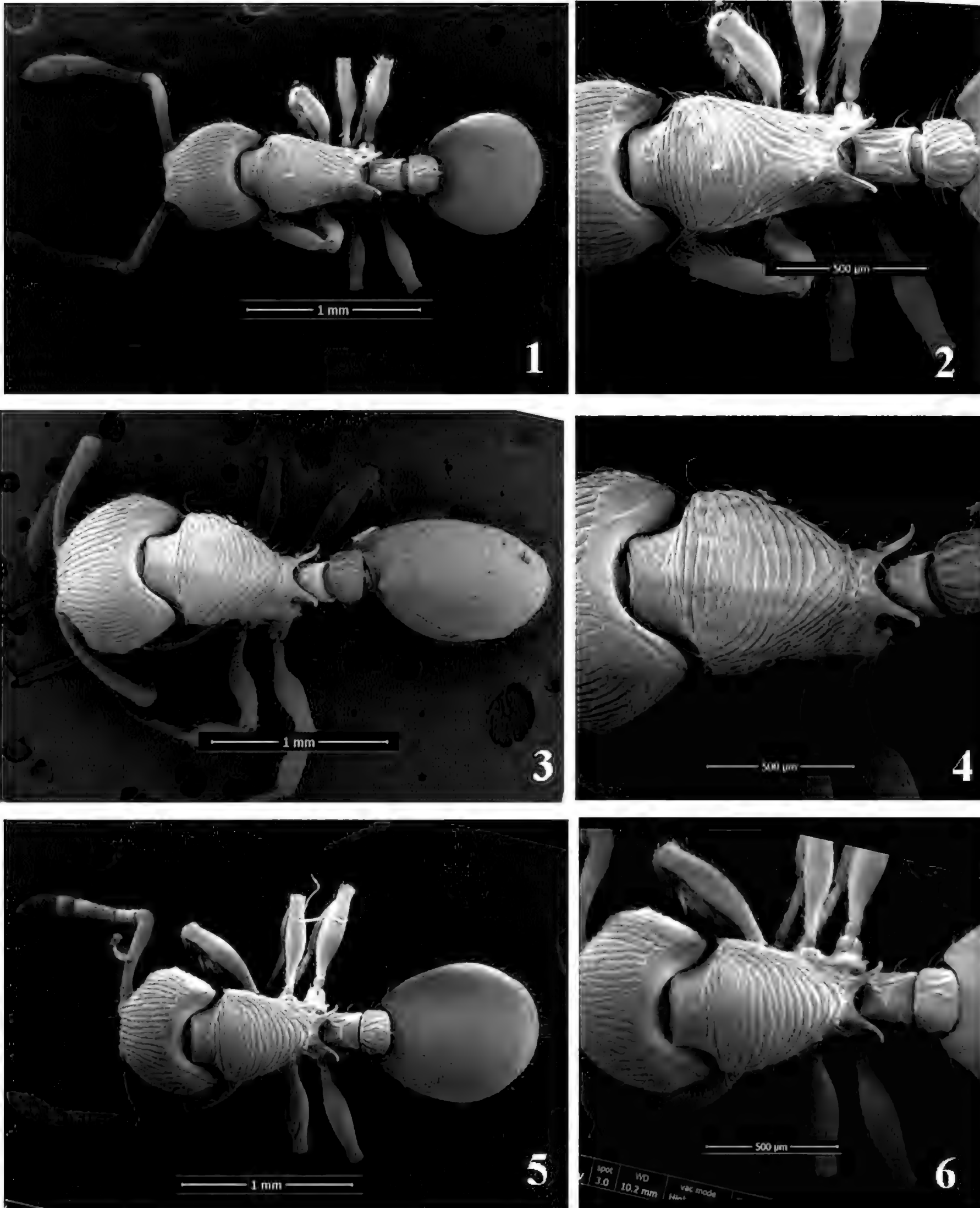
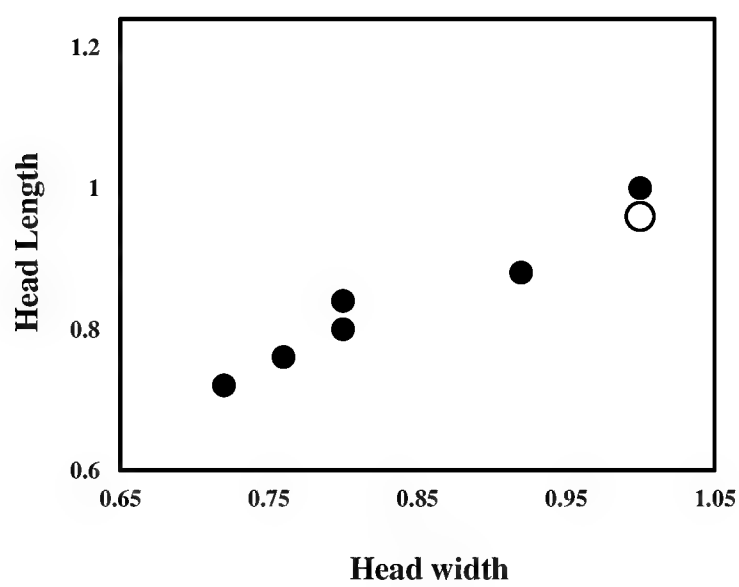
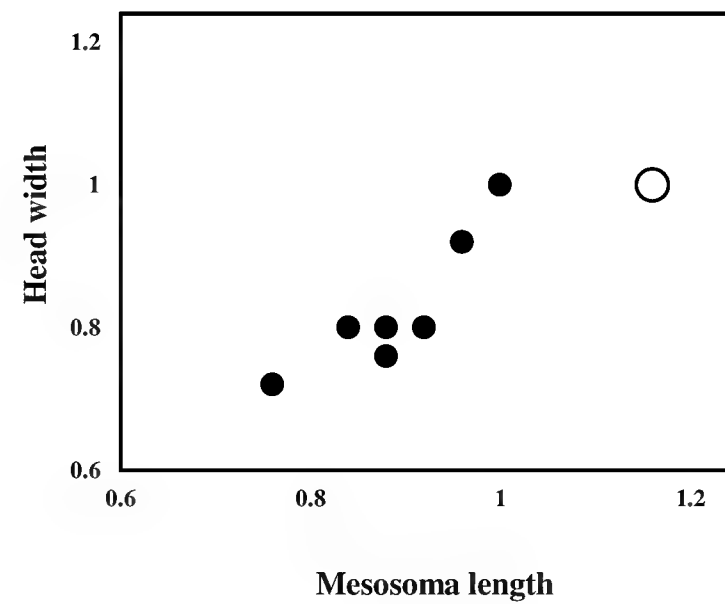


Plate 3. Figures 1-6. *M. urbanii* workers of different sizes: **1. & 2.** Small worker, dorsal view. **3. & 4.** Medium size worker, dorsal view. **5. & 6.** Larger worker, dorsal view.

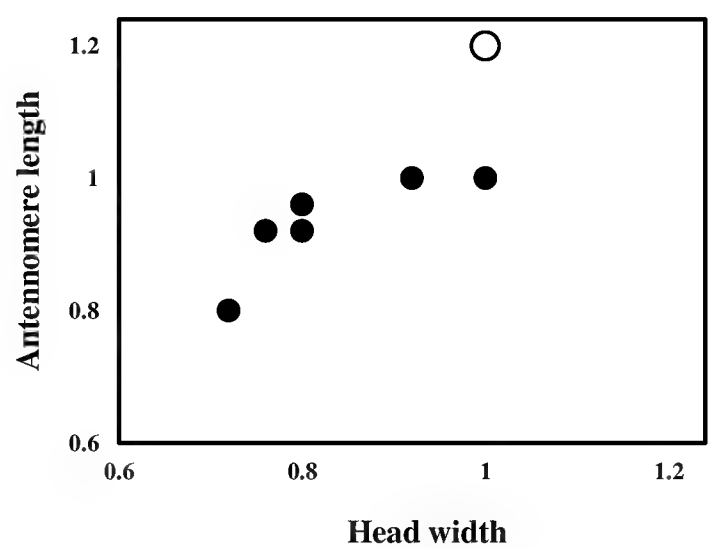
Plate 4



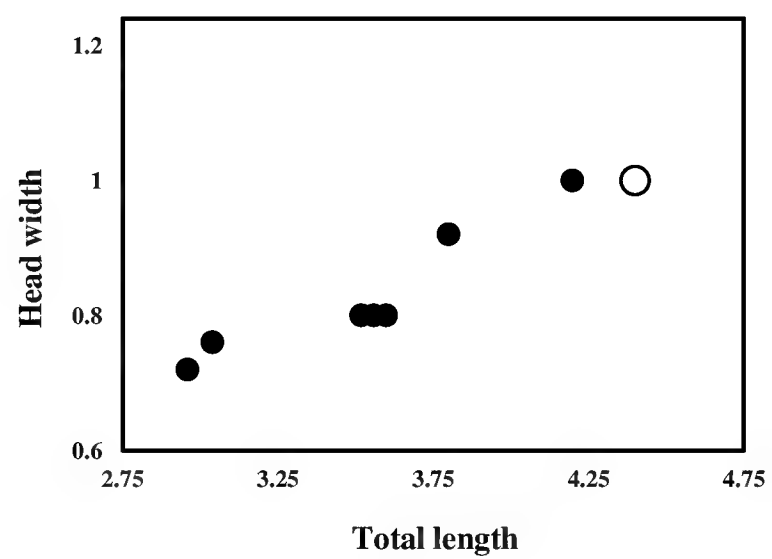
1



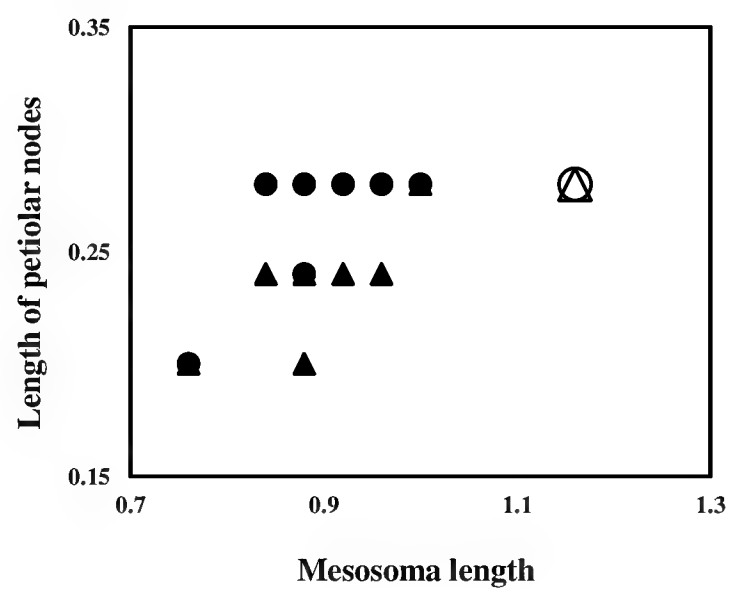
2



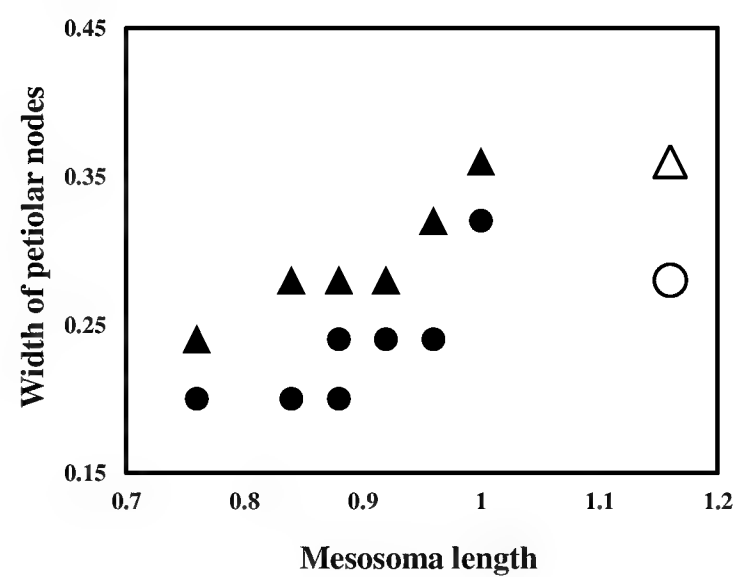
3



4



5



6

Plate 4. Figures 1–6. Bivariate plots of various morphometric measurements of *M. urbanii* dealate and workers. **1.** Head length versus head width. **2.** Head width versus mesosoma length. **3.** Antennomere length versus head width. **4.** Head width versus total length. **5.** Length of petiolar segments versus mesosoma length. **6.** Width of petiolar segments versus mesosoma length (Open bullets denote dealate and closed ones denote workers).

Plate 5

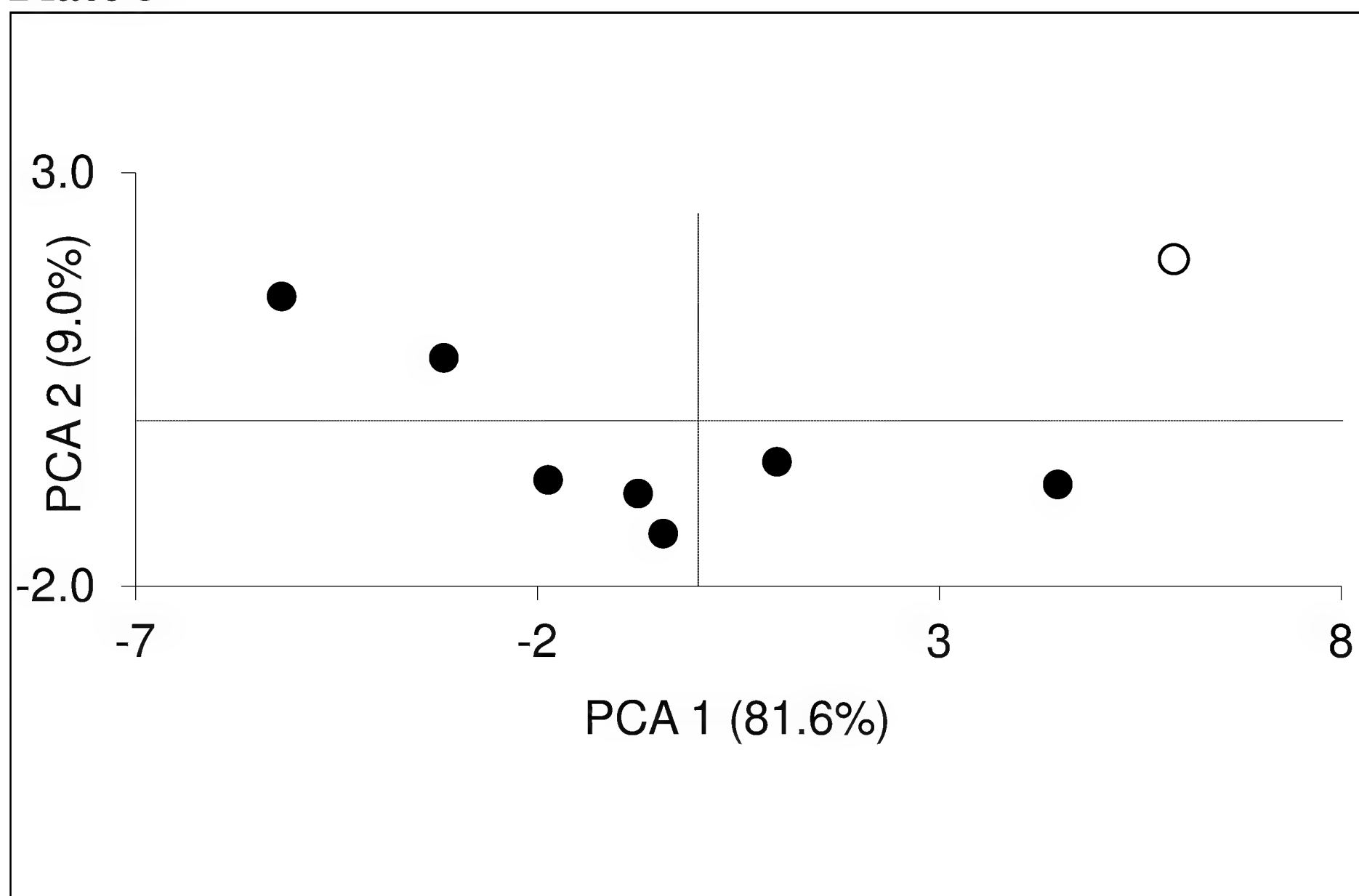


Plate 5. Principal Component analysis of various body parameters of *Myrmecina urbanii* dealate and workers (Open bullets denote dealate and closed ones denote workers).

Morphometric values of different parameters show extensive variations across worker castes. One of the workers seems to be very close to the dealate in many of the body parameters (Plate 4 and 5). As shown in Table 1, the highest value for the above parameters and other parameters in some worker castes are very similar to those of dealates. Additionally, there are two specimens (W4 and W5 in Table 1), which are smaller in measurements than that of earlier specimens. The morphometric values of those two specimens are lesser than that of the smaller specimens in the earlier report by Tiwari (1994) (Table 1). More samples from different colonies and all individuals of at least a few colonies will be needed to fully understand the colony structure in this ant species.

Distribution and Biology: This genus and species was described from India, Kerala,

Thekkady, for the first time by Tiwari (1994). Sunil *et al.* (1997), Narendra & Kumar (2006) and Varghese (2004) reported this species in Bangalore, Karnataka. Later studies by Saranya *et al.* (2013), Parui *et al.* (2015) and Bharti *et al.* (2016) reported this species from Periyar, Orissa and Tamil Nadu respectively. Further observations by this author revealed that this species nests in leaf litter. It forages individually and has the ability to hide swiftly among the leaf litter.

Discussions

Considering the existence of queen polymorphism and intercastes (Kutter, 1977; Ohkawara *et al.*, 1993; Murakami *et al.*, 2002; Buschinger and Schreiber, 2002; Buschinger *et al.*, 2003; Steiner *et al.*, 2006; Okada *et al.*, 2013) in many species of *Myrmecina* and other genera, it is reasonable to assume that their

might exist an intercaste in *M. urbanii* as well. Since the ovarian status of *M. urbanii* individuals was not studied, individuals have not been classified formally into workers and intercastes, though the presence of an intercaste is suspected, as indicated by their morphology and by their morphometric values. Even though some of these forms are very similar to dealates (in many parameters), none of them possessed ocelli. The study by Ohkawara *et al.* (1993) reported that most of the medium intercastes and all major intercastes of *M. graminicola nipponica*, possessed one ocelli and well developed ovarioles, while the minor intercastes lack ocelli, but possessed a spermatheca. The striations, especially on the mesosoma clearly vary across the different size forms and are as seen in figures from 1-6 in Plate 3. The “Y” pattern is almost missing in larger bodied individuals and the mesonotum tends to differentiate from pronotum, suggesting a similar pattern of clear differentiation of mesonotum, as observed in major intercastes, alates and queen of *M. graminicola nipponica*.

Without a detailed study of individuals from different colonies, including morphometric measurements and dissections to check for the ovarian status, it is difficult to conclude whether these inter-individual variations are caused by the presence of intercastes, worker or queen polymorphism. The morphometric measurements do not indicate any allometric growth causing soldier castes, which rules out the possibility of any soldier caste in this species. On the contrary, the presence of at least 2 individuals, which are almost as large as dealate in body length and gaster length, and few individuals intermediate between these individuals and the typical worker form, might be indicating an “intercaste” in this species.

Acknowledgements

The Ministry of Environment and Forests, Government of India supported this work. I express my profound sense of gratitude to my teacher, Prof. Raghavendra Gadagkar, Centre for Ecological Sciences, Indian Institute of Science, for his constant encouragement and support throughout my study. I thank, Dr. Shattuck Steven O., for valuable comments on an earlier version of this manuscript. I thank Mr.

Kannan and Mr. Sathyanarayan, SSCU for help with the SEM images.

References

- Bharti H., Guénard B., Bharti M. and Economo E.P. 2016. An updated checklist of the ants of India with their specific distributions in Indian states (Hymenoptera, Formicidae). *ZooKeys* 551: 1-83.
- Buschinger, A. 2001. *Myrmecina graminicola*, eine versteckt lebende Ameise mit ungewöhnlichen Eigenschaften. *Ameisenschutz aktuell* 15: 1-19.
- Buschinger, A. 2003. Mating behaviour in the ant, *Myrmecina graminicola* (Myrmicinae). *Insectes Sociaux* 50: 295-296.
- Buschinger, A. 2005. Experimental evidence for genetically mediated queen polymorphism in the ant species *Myrmecina graminicola* (Hymenoptera: Formicidae). *Entomologia Generalis* 27: 185-200.
- Buschinger, A., Schlick-Steiner, B.C., Steiner, F.M. and Espadaler, X. 2003. On the geographic distribution of queen polymorphism in *Myrmecina graminicola* (Hymenoptera: Formicidae). *Myrmecologische Nachrichten* 5: 37-41.
- Buschinger, A. and Schreiber, M. 2002. Queen polymorphism and queen-morph related facultative polygyny in the ant, *Myrmecina graminicola* (Hymenoptera: Formicidae). *Insectes Sociaux* 49: 344-353.
- Buschinger, A. and Winter, U. 1975. Der Polymorphismus der sklavenhaltenden Ameise *Harpegnathos sublaevis* (Nyl.) (Hymenoptera: Formicidae). *Insectes Sociaux* 22: 333-362.
- Curtis, J. 1829. *British entomology; being illustrations and descriptions of the genera of insects found in Great Britain and Ireland*. 6: 242-289: London.
- Düßmann, O., Peeters, C. and Hölldobler, B. 1996. Morphology and reproductive behaviour of intercastes in the ponerine ant *Pachycondyla obscuricornis*. *Insectes Sociaux* 43: 421-425.
- Francoeur, A., Loiselle, R. and Buschinger, A. 1985. Biosystématique de la tribu Leptothoracini (Hymenoptera: Formicidae). 1. Le genre *Formicoxenus* dans la region

- holarctique. Naturaliste Canadien 112: 343-403.
- Huang, J.H., Huang, Y. and Zhou, S.Y. 2008. A new species of the genus *Myrmecina* Curtis, 1829 (Hymenoptera: Formicidae) from Hunan Province, China. Acta Zootaxonomica Sinica 33: 275-278.
- Kikuchi, T., Higashi, S. and Murakami, T. 1999. A morphological comparison of alates between monogynous and polygynous colonies of *Myrmica kotokui* in northernmost Japan. Insectes Sociaux 46: 250-255.
- Kutter, H. 1916. Eine myrmecologische Excursion nach dem Südfuss der Alpen. Mitteilungen der Schweizerischen Entomologischen Gesellschaft 12: 344-348.
- Kutter, H. 1977. Hymenoptera Formicidae. In: Insecta Helvetica Fauna, Bd. 6. Schweizerische Entomologische Gesellschaft: Zürich, 297 pp.
- Miyazaki, S., Murakami, T., Kubo, T., Azuma, N., Higashi, S. and Miura, T. 2010. Ergatoid queen development in the ant *Myrmecina nipponica*: modular and heterochronic regulation of caste differentiation. Proceedings of Royal Society, B: 277: 1953-1961.
- Molet, M., Fisher, B., Itto, F. and Peeters, C. 2009. Shift from independent to dependent colony foundation and evolution of “multi-purpose” ergatoid queens in *Myrmica* ants (Subfamily: Amblyoponinae). Biological Journal of Linnaean Society 98: 198-207.
- Molet, M., Wheeler, D.E. and Peeters, C. 2012. Evolution of novel mosaic castes in ants: Modularity, phenotypic plasticity, and colonial buffering. The American Naturalist 180: 328-341.
- Murakami, T., Ohkawara, K. and Higashi, S. 2002. Morphology and developmental plasticity of reproductive females in *Myrmecina nipponica* (Hymenoptera: Formicidae). Annals of the Entomological Society of America 95: 577-582.
- Narendra, A. and Sunil, K.M. 2006. On a trail with ants. A handbook of the ants of Peninsular India. 198 pp.
- Ohkawara, K., Ito, F. and Higashi, S. 1993. Production and reproductive function of intercastes in *Myrmecina graminicola nipponica* (Hymenoptera: Formicidae). Insectes Sociaux 40: 1-10.
- Okada, Y., Plateaux, L. and Peeters, C. 2013. Morphological variability of intercastes in the ant *Temnothorax nylanderi*: pattern of trait expression and modularity. Insectes Sociaux 60: 319-328.
- Parui, A.K., Chatterjee S. and Basu, P. 2015. Habitat characteristics shaping ant species assemblages in a mixed deciduous forest in eastern India. Journal of Tropical Ecology 31: 267-280.
- Peeters, C.P. 1991. Ergatoid queens and intercastes in ants: two distinct adult forms which look morphologically intermediate between workers and winged forms. Insectes Sociaux 38: 1-15.
- Peeters, C.P. 2012. Convergent evolution of wingless reproductives across all subfamilies of ants, and sporadic loss of winged queens (Hymenoptera: Formicidae). Myrmecological News 16: 75-91.
- Plateaux, L. 1970. Sur le polymorphisme social de la fourmi *Leptothorax nylanderi* (Forster) 1. Morphologie et biologie comparées des castes. Annales des Sciences Naturelles Zoologie et Biologie Animale 12: 373-478.
- Saranya, S., Anu, A., Giji, J.K. and Shaju, T. 2013. A study on the ant diversity (Hymenoptera: Formicidae) of Periyar Tiger Reserve in South Western Ghats. The Indian Forester 139 (10): 936-942.
- Shattuck, S.O. 2009. A revision of the Australian species of the ant genus *Myrmecina* (Hymenoptera: Formicidae). Zootaxa 2146: 1-21.
- Steiner, F.M., Schlick-Steiner, B.C., Konrad, H., Linksvayer, T.A., Quek, S.P., Christian, E., Stauffer, C. and Buschinger, A. 2006. Phylogeny and evolutionary history of queen polymorphic *Myrmecina* ants (Hymenoptera: Formicidae). European Journal of Entomology 103 (3): 619-626.
- Sunil, K.M., Srihari, K.T., Nair, P., Varghese, T. and Gadagkar R. 1997. Ant species richness at selected localities of Bangalore. Insect Environment 3: 3-5.

- Tiwari, R.N. 1994. Two new species of a little known Genus *Myrmecina* Curtis (Insecta: Hymenoptera: Formicidae) from Kerala, India. Records of the Zoological Survey of India 2 - 4: 151-158.
- Tsuji, K., Ohkawara, K. and Ito, F. 2001. Inter-nest relationship in the Indonesian ant, *Myrmecina* sp. A with some considerations for the evolution of uniclonality in ants. Tropics 10 (3): 409-420.
- Varghese, T. 2004. Taxonomic studies on ant genera of the Indian Institute of Science Campus with notes on their nesting habits. Perspectives on Biosystematics and biodiversity T.C.N. Commemoration volume 485-502.
- Wong, M.K.L. and Guénard, B. 2016. First confirmed record of the ant genus *Myrmecina* (Hymenoptera, Formicidae) from the Malay Peninsula: description of a new species and a key to *Myrmecina* species from Sundaland. Journal of Hymenoptera Research 50: 129-140.
- Zhou, S., Huang, J. and Ma, L. 2008. Two new species of the ant genus *Myrmecina* (Hymenoptera: Formicidae), with a key to Chinese species. Sociobiology 52: 283-291.

A checklist of Syrphidae (Diptera) from Mordovia, Russia

Mariya A. Chursina¹ and Alexander B. Ruchin^{2*}

¹*Voronezh State University, Universitetskaya sq., 1, 394006 Voronezh, Russia.*

²*Mordovia State Nature Reserve; 431230 Republic of Mordovia, Temnikov District, Pushta settlement, Russia.*

(Email: ruchin_mgpz@mail.ru)

Abstract

The fauna of the family Syrphidae in Mordovia is completely unstudied and comprises about forty three species, which are known by just a few records from 2005 to 2016. In this paper, a checklist of Syrphidae in Mordovia is presented, which includes 61 species recorded in the region for the first time.

Keywords: *Diptera, Syrphidae, fauna, hoverfly, new record, Mordovia.*

Received: 28 September 2017; Revised: 5 April 2018; Online: 30 May 2018.

Introduction

The family Syrphidae is one of the largest and widespread families of Diptera. Recent estimates indicate that there are over 6000 described species, belonging to about 200 genera. Syrphid flies can be small and large ones, 4–25 mm long and they greatly diverse in morphology and environmental requirements. Dipterous representatives of the family can have black body, but they often have yellow or golden markings, particularly on abdomen, thereby they mimic Hymenoptera species. One of the main diagnostic characters is the structure of wing venation: apex of medial vein bent strongly forward and forming apical cross vein (Vockeroth and Thompson, 1987).

Larvae of Syrphidae prefer a diverse array of habitats. For instance, immature stages of the subfamily Syrphinae are predaceous on soft-bodied arthropods, larvae of Eristalinae subfamily can be coprophagous (Milesiini), mycetophagous (some species of Rhingiini), phytophagous (most species of Merodontini and some species of Brachyopini) or aquatic filter feeders (mainly Eristalini) (Thompson and Vockeroth, 1989).

Most species of the family have economic importance. Adults of the family are significant pollinators of many plants including vegetables, fruit trees and flowering plants (Kevan and Baker, 1983).

Larvae are important predators of many pests so play important part in their biological control. Following Sommaggio (1999) it seems important to note, that syrphid flies are potentially good bioindicators.

The syrphid flies are widespread, there are cosmopolitans among them (for example, *Syrpitta pipiens* (Linnaeus, 1758), *Eristalinus aeneus* (Scopoli, 1763), *Eumerus funeralis* Meigen, 1822); some syrphids are highly migratory (*Eristalis tenax* (Linnaeus, 1758), *Sphaerophoria scripta* (Linnaeus, 1758), *Syrphus ribesii* (Linnaeus, 1758)) and can reach offshore islands. The most complete review of the geographical range, ecological amplitude, flowers visited and flight period of syrphid species was provided by Speight (2014).

There is no comprehensive revision of the family Syrphidae from Russia, but several recent studies were devoted to syrphid fauna of different regions, such as Kirov Region (Pestov *et al.*, 2010), Nizhniy Novgorod Region (Anufriev and Soshnikov, 1984), Moscow Region (Zimina, 1957, 1981, 1986), Leningrad Region (Stackelberg, 1958), Vologda Region (Belova *et al.*, 2008), South Ural (Sorokina and Chashchina, 2003; Sorokina, 2006), Sakhalin and Kuril Islands (Mutin

and Barkalov, 1997) and Komi Republic (Pestov, 2010).

The literature data on the fauna of Syrphidae family in Mordovia are not numerous. The first checklist of the Syrphidae family from this region was a summary of entomological data of Mordovia State Nature Reserve collected from 1938 to 1948, provided by Plavilshchikov (1964) and included 19 species belonging to eight genera. It is clear that they are a small part of species, which are actually presented in the Reserve.

A number of syrphid species have been noted later by Antsiferova and co-authors in 1966–1979 and Ruchin in 2007–2008. Feoktistov (2011) has provided an additional data on the syrphid fauna from the author's collection on the territory of Mordovia Nature Reserve.

This study is devoted to diversity of the syrphid flies in Mordovia, above all, in Mordovia State Nature Reserve. This paper presents new records of 61 syrphid species and provides additional information for the distribution of species, which have been recorded for the territory earlier.

Study area

The Republic of Mordovia is located in the center of East European Plain between 42°11' and 46°45' east longitude and 53°38' and 55°11' north latitude in southwestern periphery of the Volga basin, between the rivers Moksha and Sura. Maximum length from west to east is 298 kms and from north to south it is 140 kms. The territory is located on the border of the forest and forest-steppe zones of Central Russia. The eastern part of Mordovia is located in the north-west of the Volga Upland, and the western part – in the Oka-Don lowland. In this regard, a variety of habitats is observed in the study area (Fig. 1). Boreal coniferous and mixed forests are common in the west, north-west and north of the republic. In the central and eastern parts of the area, there are broad-deciduous forests. Forest-steppe landscapes predominate in the east and southeast

(Yamashkin, 2014; Ruchin and Egorov, 2017).

Elements of steppe vegetation occur on a small number of sites unsuitable for agricultural use (on slopes of ravines, on hills and on the banks of the river valleys). However, the number of steppe areas may increase due to vegetation overgrowth on sedimentary deposits, especially near steep slopes covered by steppe formations. It is associated with a reduction of grazing impact, reflected in the overgrowth of populations of several steppe grasses. On some slopes, however, this overgrowth corresponds mainly to mesophilic grasses. These areas are usually colonized by shrubs and trees. The forest area is also increasing due to seed renewal of tree species in fallow lands, which are adjacent to forest areas.

Data collection and analysis

The material for this study was collected from April to October during 2005 to 2016 on the territory of Mordovia State Nature Reserve (MSNR) (Republic of Mordovia, Russia) and adjacent territories by A. B. Ruchin and officers of MSNR. Different types of Diptera habitats were investigated, including secondary deciduous forest, pine forests, old-growth mixed and pine forests, flood plain oak forests, meadows, cuttings and forest borders, steppe plots, wastelands, water-meadows, meadows, dry meadows (Table 1; Fig. 2).

Collections were made by individual hand nets, and then specimens were installed on entomological pins. Specimens were identified to the species level by M. A. Chursina using relevant taxonomic literature: Stackelberg (1933, 1970), Vockeroth and Thompson (1987), Miranda *et al.* (2013).

A checklist of Syrphidae in Mordovia is given below. Some old names (synonyms and homonyms) are replaced by new names according to Fauna Europea (2000–2015). The material of recorded species is deposited in the collection of biological museum of the MSNR.



Fig. 1. Location of the Republic of Mordovia in Eastern Europe.

Table 1. List of locality visited.

S. No.	Locality	Latitude	Longitude
1.	Saransk	54° 10' 41.7" N	45° 11' 4.0" E
2.	Ardatov Dist., village KrasnyePoljany	54° 55' 46.1" N	46° 17' 46.4" E
3.	Atyuryevo Dist., village MordovskayaKozlovka	54° 27' 45.6" N	43° 18' 37.5" E
4.	Ardatovo Dist., railway station Svetotehnika	54° 47' 8.7" N	46° 20' 23.6" E
5.	Bolshie Berezniki Dist., village Gart	54° 8' 41.5" N	45° 38' 19.6" E
6.	Bolshie Berezniki Dist., village Permissi	54° 5' 45.3" N	45° 49' 40.5" E
7.	Bolshie Berezniki Dist., village Nerley	54° 4' 41.9" N	45° 42' 14.5" E
8.	Bolshie Berezniki Dist., village Degilevka	54° 9' 26.1" N	45° 40' 47.7" E
9.	Bolshie Berezniki Dist., 9 km S village Simkino	54° 15' 16.5" N	46° 10' 22.0" E
10.	BolshoeIgnatovo Dist., 4 km S village Barahmany	54° 53' 47.6" N	45° 35' 43.2" E
11.	Dubenki Dist., 8 km S village Engalychevo	54° 18' 55.1" N	46° 22' 19.7" E
12.	ElnikiDist, village NovieShali	54° 42' 14.8" N	43° 37' 52.9" E
13.	Elniki Dist., village MalyeMordovskiePoshaty	54° 41' 2.5" N	43° 43' 9.5" E
14.	ZubovoPolyana Dist., village Tenishevo	54° 24' 27.7" N	42° 41' 45.2" E
15.	ZubovoPolyana Dist., village Lesnoy	54° 27' 36.7" N	42° 42' 36.7" E
16.	ZubovoPolyana Dist., settlem. Yavas	54° 25' 1.9" N	42° 50' 41.0" E
17.	Ichalki Dist., 2 km NW village Hanineevka	54° 21' 29.9" N	45° 8' 49.2" E
18.	Ichalki Dist., Kemljanskoe forestry, settlem. Smolny	54° 50' 4.4" N	45° 22' 42.5" E
19.	Ichalki Dist., Barakhmanovskoe forestry	54° 44' 28.7" N	45° 34' 57.2" E
22.	Kochkurovo Dist., village Sabaevo	53° 59' 35.5" N	45° 43' 23.8" E
21.	Kochkurovo Dist., village StaryeTurdaki	53° 54' 49.9" N	45° 28' 30.5" E
22.	KrasnoslobodskDist, Krasnoslobodsk	54° 25' 44.8" N	43° 47' 35.1" E
23.	KrasnoslobodskDist, village Sinjakovo	54° 25' 40.8" N	43° 40' 57.1" E
24.	Lyambir Dist., village Atemar	54° 11' 3.1" N	45° 23' 51.0" E
25.	Lyambir Dist., village Ekaterinovka	54° 9' 1.9" N	45° 33' 1.5" E
26.	Ruzaevka Dist., 3 km N village StreleckajaSloboda	54° 11' 54.6" N	44° 42' 16.4" E
27.	StaroeShaygovoDist, village StaroeAkshino	54° 17' 27.2" N	44° 42' 55.8" E
28.	StaroeShaygovo Dist., village Govorovo	54° 27' 36" N	44° 50' 17" E
29.	StaroeShaygovo Dist., village Lesnichestvo	54° 18' 22.9" N	44° 28' 16.6" E
30.	StaroeShaygovo Dist., village Konopat	54° 21' 09" N	44° 53' 49" E
31.	Temnikov Dist., village Veseliy	54° 32' 52.5" N	43° 0' 58.2" E
32.	Temnikov Dist., village Lavrentevo	54° 29' 27.0" N	43° 2' 54.9" E
33.	Temnikov Dist., MSNR, village Pushta	54°43'07.1" N	43°13'32.2" E
34.	Temnikov Dist., MSNR, 6 km NW village Pushta	54°44'15.3" N	43°08'53.2" E
35.	Temnikov Dist., MSNR, 5 km N village Pushta	54°44'52.0" N	43°12'04.2" E
36.	Temnikov Dist., MSNR, cordon Polyanski	54°46'36.5" N	43°28'47.1" E
37.	Temnikov Dist., MSNR, cordon Podrubnyj	54°47'51.5" N	43°08'48.4" E
38.	Temnikov Dist., MSNR, cordon Plotomoyka	54° 49' 53.2" N	43° 8' 17.0" E
39.	Temnikov Dist., Temnikov	54° 37' 53.9" N	43° 13' 0.5" E
40.	Temnikov Dist., MSNR, cordon Noven'kovskij	54°55'50.2" N	43°25'18.1" E
41.	Temnikov Dist., MSNR, cordon Taratinski	54°44'50.6" N	43°05'09.1" E
42.	Temnikov Dist., MSNR, cordon SrednjaMel'nica	54°54'09.4" N	43°13'53.5" E
43.	Temnikov Dist., MSNR, cordon Steklyanny, zone 86	54°53'38.1" N	43°35'59.4" E
44.	Temnikov Dist., village Tarhany	54° 32' 20.0" N	43° 24' 34.3" E
45.	Temnikov Dist., village Tretjakovo	54° 31' 59.4" N	43° 12' 54.1" E
46.	Temnikov Dist., MSNR, zone 35	54°53'27.3" N	43°11'20.5" E
47.	Temnikov Dist., MSNR, zone 79	54°53'38.1" N	43°34'57.7" E
48.	Temnikov Dist., MSNR, zone 274	54°47'45.4" N	43°10'28.5" E
49.	Temnikov Dist., MSNR, zone 278	54°47'51.4" N	43°12'27.1" E
50.	Temnikov Dist., MSNR, zone 342	54°47'06.3" N	43°19'40.0" E
51.	Temnikov Dist., MSNR, zone 345	54°47'07.1" N	43°19'41.3" E
52.	Temnikov Dist., MSNR, zone 360	54°46'11.2" N	43°13'43.4" E
53.	Temnikov Dist., MSNR, zone 364	54°46'24.2" N	43°17'45.8" E
54.	Temnikov Dist., MSNR, zone 368	54°46'37.5" N	43°21'45.1" E
55.	Temnikov Dist., MSNR, zone 381	54°45'24.0" N	43°09'50.5" E
56.	Temnikov Dist., MSNR, zone 384	54°45'33.1" N	43°12'44.5" E
57.	Temnikov Dist., MSNR, zone 385	54°45'36.4" N	43°13'48.7" E
58.	Temnikov Dist., MSNR, zone 389	54°45'50.0" N	43°17'50.5" E
59.	Temnikov Dist., MSNR, zone 397	54°46'21.3" N	43°23'47.6" E
60.	Temnikov Dist., MSNR, zone 398	54°46'22.1" N	43°25'48.3" E

Syrphidae (Diptera) from Mordovia, Russia

61.	Temnikov Dist., MSNR, zone 404	54°44'43.3" N	43°07'56.8" E
62.	Temnikov Dist., MSNR, zone 417	54°45'23.5" N	43°20'56.3" E
63.	Temnikov Dist., MSNR, zone 420	54°45'10.7" N	43°24'05.5" E
64.	Temnikov Dist., MSNR, zone 427	54°42'25.3" N	43°24'11.5" E
65.	Temnikov Dist., MSNR, zone 430	54°44'34.1" N	43°16'00.3" E
66.	Temnikov Dist., MSNR, zone 434	54°51'46.3" N	43°09'02.2" E
67.	Temnikov Dist., MSNR, zone 435	54°43'26.4" N	43°08'09.7" E
68.	Temnikov Dist., MSNR, zone 440	54°43'50.3" N	43°13'05.0" E
69.	Temnikov Dist., MSNR, zone 442	54°43'56.5" N	43°15'02.1" E
70.	Temnikov Dist., MSNR, zone 446	54°43'32.1"N	43°08'32.8"E
71.	Temnikov Dist., MSNR, zone 447	54°41'42.3" N	43°22'12.4" E
72.	Temnikov Dist., MSNR, zone 448	54°42'42.3" N	43°12'12.1" E
73.	Tengushevo Dist., village Hlebino	54° 37' 54.9" N	42° 49' 29.6" E
74.	Tengushevo Dist., 6 km NW village Barashevo	54° 32' 7.4" N	42° 52' 34.7" E
75.	Tengushevo Dist., village Klemeshhej	54° 35' 10.7" N	42° 51' 39.0" E
76.	Tengushevo Dist., village Dachniy	54° 33' 21.2" N	42° 38' 2.1" E
77.	Torbeevo Dist., villageSurgod	54° 02' 42" N	43° 05' 59" E
78.	Torbeevo Dist., village Drakino	54° 03' 05" N	43° 15' 58" E
79.	Torbeevo Dist., village Varzhelja	54° 11' 12.3" N	43° 7' 15.8" E
80.	Torbeevo Dist., village Vindrey	54° 15' 25.9" N	42° 59' 12.8" E
81.	Ruzaevka Dist., village Levzhensky	54° 6' 32.7" N	45° 4' 22.8" E
82.	Ruzaevka Dist., station Paygarm	54° 4' 36.4" N	44° 50' 22.4" E
83.	Chamzinka Dist., village Komsomolskij	54° 26' 28.1" N	45° 50' 2.3" E
84.	Chamzinka Dist., village Gorbunovka	54° 24' 22" N	45° 46' 34" E
85.	Atjashevo Dist., village Atjashevo	54° 35' 23" N	45° 06' 04" E
86.	Ichalki Dist., village Selishhi	54° 44' 23" N	45° 38' 36" E





Fig. 2. The biotopes of Republic of Mordovia: A – Ardatovo District, environs of railway station Svetotekhnika, the border of deciduous forest; B – Bolshie Berezniki District, environs of vill. Gart, steppeified slope with outcrop of carbonates; C – Ruzaevka District, environs of vill. Levzhensky, steppe land with a feather-grass; D – Ichalki District, Smolny, Barakhmanovskoe forestry water-meadow; E – Temnikov District, MSNR, 5 km toward the north from vill. Pushta, zone 408, pine forest; F – ZubovoPolyana District, toward southwest from vill. Pusha, swamp with cotton-grass.

Material examined

This paper presents records for 103 syrphid species in Mordovia belonging to 44 genera. Sixty-one species are recorded for the first time from the region and are marked with “*”.

**Anasimyia lineata* (Fabricius, 1787)

Material. 1♀: **6** (12.vi.2012).

Distribution. From central and southern Norway through central Europe to the Pacific coast.

**Blera fallax* (Linnaeus, 1953)

Material. 1♂: **33** (30.v.2008); 1♀: **57** (27.v.2016). (Fig. 3).

Distribution. From central and southern Norway through central Europe to the Pacific coast.

**Brachypalpoides lentus* (Meigen, 1822)

Material. 2♀♀: **21** (12.vi.2008); 1♂: **24** (29.v.2008); 1♂: **82** (11.iv.2006).

Distribution. From Ireland through central Europe into European parts of Russia; from southern Europe eastwards to the former Yugoslavia and Greece and further into Syria.

**Callicera aenea* (Fabricius, 1781)

Material. 2♂♂: **25** (29.v.2008); 1♂: **35** (19.v.2013).

Distribution. Norway, Sweden, Poland, Czech Republic, France, Germany, European part of Russia: to the south to the Crimea and to the east till Siberia and Sakhalin.

Ceriana conopsoides (Linnaeus, 1758)

Material. 1♂: **36** (24.vii.2015); 1♀: **63** (25.v.2015).

Distribution. From Finland to the Mediterranean and North Africa, Central Europe, Asian part of Russia to the Pacific Ocean, China.

Chalcosyrphus nemorum (Fabricius, 1805)

Material. 1♂: **61** (26.v.2016).

Distribution. From Fennoscandia to the Pyrenees; from Ireland through much of Europe to Russia and on to the Pacific coast; from Alaska to Nova Scotia and south to California.

**Chalcosyrphus nitidus* (Portschinsky, 1879)

Material. 1♂: **54** (7.vi.2015).

Distribution. Russia, Ukraine, Northern China.

Chalcosyrphus piger (Fabricius, 1794)

Material. 1♂: **50** (25.v.2015); 1♂, 1♀: **65** (9.v.2013, 23.vi.2013); 1♂: **71** (26.v.2015).

Distribution. From Northern France through Central Europe to Asian part of Russia.

Chalcosyrphus valgus (Gmelin, 1790)

Material. 1♂: **7** (5.vi.2016); 1♂: **25** (29.v.2008); 1♀, 1♂: **33** (30.v.2008); 1♂: **34** (21.v.2016); 1♂: **36** (18.v.2014); 1♂: **37** (15.v.2016); 1♀: **39** (1.vi.2008); 2♂♂: **50** (25.v.2015, 31.v.2015); 1♀: **51** (31.v.2015); 1♀: **65** (12.vi.2008).

Distribution. Scandinavia, central and southern Europe, Asian part of Russia, China.

**Cheilosia albipila* (Meigen, 1838)

Material. 2♀♀: **34** (27.iv.2014); 1♂: **38** (20.v.2005).

Distribution. From Ireland to central Siberia.

Cheilosia albitarsis (Meigen, 1822)

Material. 1♂, 1♀: **18** (21.v.2008); 1♂: **25** (2.vi.2009); 1♀: **61** (26.v.2016).

Distribution. Whole Palearctic except the Far North.

****Cheilosia brunnipennis* (Becker, 1894)**

Material. 1♂, 1♀: **24** (7.v.2016).

Distribution. From France to the south of Russia, Israel, North Africa.

****Cheilosia chrysocoma* (Meigen, 1822)**

Material. 1♂: **34** (10.v.2013); 1♀: **36** (18.v.2014).

Distribution. Scandinavia, the north of Spain, Italy, Bulgaria, East Ireland, Central Europe, European part of Russia and Siberia.

****Cheilosia flavipes* (Panzer, 1798)**

Material. 1♀: **18** (21.v.2008); 1♀: **31** (25.v.2013); 1♀: **35** (16.v.2015); 1♀: **83** (14.vii.2008).

Distribution. From Sweden and Finland to Western Siberia.

****Cheilosia grossa* (Fallen, 1817)**

Material. 1♂: **1** (7.iv.2008); 1♂: **19** (09.iv.2008).

Distribution. Fennoscandia, central and southern Europe, Asian part of Russia (Siberia), this species was recorded in the eastern region (India) and Africa (Morocco).

****Cheilosia illustrata* (Harris, 1780)**

Material. 1♀, 1♂: **19** (20.vii.2007); 1♀: **29** (17.vii.2009); 1♀: **34** (25.vii.2009); 1♀: **65** (13.vi.2016).

Distribution. From Fennoscandia, Spain and Italy to Western Siberia.

****Cheilosia impressa* (Loew, 1840)**

Material. 2♂♂, 2♀♀: **63** (13.vi.2016); 1♀: **65** (12.vi.2016).

Distribution. From Ireland to the east through central Europe to European parts of Russia and across Siberia to the Pacific.

****Cheilosia lasiopa* (Kowarz, 1885)**

Material. 1♂: **19** (26.iv.2008).

Distribution. From the Great Britain through Central Europe to European part of Russia.

****Cheilosia laticornis* Rondani, 1857**

Material. 1♀: **49** (14.v.2016).

Distribution. Southern Sweden, Netherlands, Poland, Czech Republic, southern Germany, France, Switzerland, Austria, Italy, Balkans, Romania, southern Russia and Ukraine on to the

Transcaucasus and Kirghizistan; Afghanistan; Turkey, Israel and North Africa.

****Cheilosia latifrons* (Zetterstedt, 1843)**

Material. 1♀: **67** (21.iv.2016).

Distribution. From Ireland through Central and Southern Europe to Western Siberia.

****Cheilosia morio* (Zetterstedt, 1838)**

Material. 1♀: **22** (5.vi.2009); 1♀: **35** (19.v.2013).

Distribution. From northern Scandinavia to northern Germany and Poland, to the east through central Europe to western Siberia and Mongolia.

***Cheilosia mutabilis* (Fallen, 1817)**

Material. 1♀: **58** (11.vi.2016).

Distribution. From the Great Britain, in most of Europe to western Siberia.

****Cheilosia pagana* (Meigen, 1822)**

Material. 1♂: **12** (26.v.2013); 1♂, 1♀: **27** (11.v.2008); 1♂: **29** (26.iv.2008); 1♀: **31** (25.v.2013); 1♂: **34** (11.v.2016).

Distribution. From Fennoscandia, Spain and Italy to western Siberia.

****Cheilosia scutellata* (Fallen, 1817)**

Material. 1♀: **47** (23.viii.2016); 1♀: **65** (12.vi.2016).

Distribution. From Fennoscandia to Iberia and round the Mediterranean to Greece, Turkey and north Africa; from Ireland eastwards through Eurasia to the Pacific coast.

****Cheilosia velutina* Loew, 1840**

Material. 1♂: **34** (9.v.2009).

Distribution. From Ireland through much of Europe into Russia and on through Siberia to the Pacific coast.

****Chrysogaster simplex* Loew, 1843**

Material. 1♀: **1** (21.iv.2008); 1♀: **3** (29.vi.2013); 1♀: **18** (24.vi.2008).

Distribution. Greece, Romania, Turkey.

****Chrysogaster solstitialis* (Fallen, 1817)**

Material. 1♀: **61** (23.iv.2016); 1♂: **65** (12.iv.2016); 1♂: **77** (21.vi.2016).

Distribution. From Fennoscandia south to the Mediterranean; north Africa; from Ireland eastwards through much of Europe into European parts of Russia; Ukraine; the Caucasus.

***Chrysotoxum bicinctum* (Linnaeus, 1758)**

Material. 1♀: **5** (19.vii.2008); 1♂: **18** (30.vi.2008); 1♂: **21** (8.vii.2008); 1♀: **34** (17.viii.2013).

Distribution. From Fennoscandia to the Mediterranean and Africa, through the central and southern Europe (Italy, Bulgaria), Turkey and European part of Russia to central Siberia.

***Chrysotoxum festivum* (Linnaeus, 1758)**

Material. 3♀♀: **1** (9.viii.2008); 1♀: **3** (8.vi.2013); 2♂♂: **6** (5-12.vi.2015); 1♂: **7** (5.vi.2016); 1♂, 1♀: **9** (30.vi.2009); 1♂: **12** (26.v.2013); 1♀, 1♂: **13** (31.v.2014); 1♂: **17** (12.vi.2009); 5♂♂, 1♀: **18** (5-28.vi.2008); 1♀: **19** (6.ix.2009); 1♂, 2♀♀: **21** (12.vi.2008); 1♂, 1♀: **25** (29.v.2008); 1♂: **31** (6.vi.2015); 1♀: **32** (6.vii.2013); 4♂♂: **33** (30.v.2008); 4♂♂: **34** (12.vii.2008, 8-12.vi.2014); 1♀: **39** (1.vi.2008); 1♂, 1♀: **51** (31.v.2015); 1♂, 2♀♀: **54** (7.vi.2015, 24.viii.2014); 1♂: **57** (27.v.2016); 1♂, 2♀♀: **60** (7.vi.2015); 1♂: **62** (03.vi.2016); 2♀♀, 1♂: **63** (7.vi.2015); 1♀: **64** (16.vi.2014); 2♂♂: **65** (23.vi.2013, 2.vi.2016); 2♂♂, 2♀♀: **66** (5.vi.2015); 1♂, 1♀: **68** (10.vi.2016); 1♀: **70** (26.v.2016); 1♀: **77** (26.vii.2016); 1♀: **78** (18.viii.2016); 2♀♀, 1♂: **81** (13-28.vi.2015); 1♂: **83** (15.vi.2008).

Distribution. From Fennoscandia to the south to Mediterranean and Africa, from Ireland to east Europe and Turkey and European part of Russia, through Siberia to the shores of the Pacific, Japan, North India.

****Chrysotoxum octomaculatum* Curtis, 1831**

Material. 1♀: **14** (2.viii.2015); 1♂: **40** (29.vi.2016).

Distribution. From England and Netherlands to the south to the Mediterranean Sea, to the east through central and southern Europe and southern Russia, to Armenia and Kazakhstan.

****Chrysotoxum verralii* Collin, 1940**

Material. 1♂: **66** (31.v.2015).

Distribution. From England to the east through most of Europe and Asia, almost to the Pacific Ocean; Iran.

***Criorhina asilica* (Fallen, 1816)**

Material. 1♀: **4** (18.v.2008); 1♀: **31** (25.v.2013); 1♂: **33** (30.v.2008); 1♂: **53** (11.vi.2016); 1♂, 1♀: **60** (31.v.2015); 2♂♂, 2♀♀: **67** (21.v.2016, 13.vi.2016); 1♂: **72** (19.v.2016).

Distribution. Central and southern Norway, Sweden, Spain, Great Britain, to the east through Central Europe, European part of Russia, Ukraine, Bulgaria, Romania.

***Criorhina ranunculi* (Panzer, 1804)**

Material. 1♂: **26** (19.v.2009); 1♂: **33** (3.v.2008); 1♂: **39** (11.iv.2008); 1♂: **65** (6.v.2015).

Distribution. From southern Norway and southern Sweden to the south, through central Europe in European part of Russia.

****Dasysyrphus tricinctus* (Fallen, 1817)**

Material. 1♂: **27** (16.viii.2008); 2♂♂: **33** (11.iv.2008, 27.vii.2015); 1♂, 1♀: **55** (24-26.v.2016); 1♀: **59** (17.viii.2014).

Distribution. From Iceland to the Pyrenees, from Ireland and Fennoscandia towards the east to central and northern Europe and Russia, to the shores of the Pacific and Japan.

***Dasysyrphus venustus* (Meigen, 1822)**

Material. 1♂: **2** (20.v.2008); 2♀♀: **7** (12.vi.2008); 1♂: **13** (23.vii.2016); 1♂, 1♀: **25** (2.vi.2009); 1♀: **26** (19.v.2009); 1♀: **27** (11.v.2008); 1♀: **31** (6.vi.2015); 1♀: **33** (30.v.2008); 1♀: **39** (1.vi.2008); 1♀: **42** (18.vi.2016); 1♂: **46** (29.v.2016); 2♀♀: **55** (26.v.2016); 1♀: **63** (25.v.2010); 1♀: **69** (2.vi.2016); 2♂♂, 1♀: **71** (26.v.2015); 1♀: **79** (7.vi.2008).

Distribution. From Fennoscandia to the south to the Pyrenees, from Ireland to the east through northern, central and mountain regions of southern Europe, European part of Russia, Siberia and the Urals to the Pacific coast (the Kuril Islands); North America from Alaska to Quebec and south to Oregon.

****Didea intermedia* (Loew, 1854)**

Material. 1♂: **18** (21.vi.2008); 1♀: **31** (6.vi.2015); 1♀: **34** (12.vii.2008); 1♂: **35** (10.vi.2012); 1♀: **40** (13.vii.2014); 1♀: **50** (22.viii.2015); 1♀: **60** (07.vi.2015); 1♀: **71** (26.v.2015); 1♀: **81** (9.vi.2009).

Distribution. From Fennoscandia towards south through the central and southern Europe, in Russia to the Pacific coast (Kamchatka).

****Epistrophe diaphana* (Gravenhorst, 1807)**

Material. 1♀: **7** (27.viii.2016); 1♀: **8** (12.vi.2015); 1♀: **54** (4.vii.2015).

Distribution. From Britain through central and southern Europe into Russia and on through Asia to the Pacific coast.

***Epistrophe grossulariae* (Meigen, 1822)**

Material. 2♀♀: **23** (19.vii.2014); 1♀: **33** (19.v.2016); 1♂, 1♀: **34** (19.v.2013, 12.vii.2008); 1♀: **38** (3.viii.2014); 1♀: **45** (17.v.2014); 1♂: **46** (18.vi.2016); 1♂: **54** (7.vi.2015); 1♀: **63** (13.vi.2016); 1♀: **71**

(26.v.2015); 2♀♀: **74** (30.vi.2013); 1♀: **77** (21.vi.2016).

Distribution. From Ireland eastwards through Eurasia to Kamchatka; Italy; North America from Alaska to Quebec and south to California.

***Episyrphus balteatus* (De Geer, 1776)**

Material. 1♂: **17** (23.vii.2008); 1♂: **28** (24.vi.2008).

Distribution. From Fennoscandia to the Mediterranean; Canary Islands, the Azores and North Africa; Ireland across Eurasia to the Pacific coast, south to Sri Lanka; Australia.

***Eristalinus aeneus* (Scopoli, 1763).**

Material. 1♀: **9** (30.vi.2015); 1♀: **14** (2.viii.2015); 1♀: **34** (1.viii.2015); 1♀: **72** (19.v.2016).

Distribution. Cosmopolitan.

***Eristalis abusiva* Collin, 1931**

Material. 1♀: **16** (5.viii.2013); 1♀: **28** (10.vii.2016).

Distribution. Fennoscandia, toward the south to north France; from east Ireland through northern and central Europe to Russia and then through Siberia to the Pacific coast.

****Eristalis alpine* Strobl, 1893**

Material. 1♀: **18** (17.vi.2008).

Distribution. From Denmark, the Netherlands and Belgium to the east through mountainous part of Central and Southern Europe to European part of Russia and Turkey, through Siberia to the Pacific coast; Mongolia.

****Eristalis anthophorina* (Fallen, 1817)**

Material. 1♂: **24** (7.v.2016); 1♂: **61** (1.vii.2016).

Distribution. From Denmark and the Netherlands eastwards through central Europe to the Pacific coast and Japan, Mongolia.

***Eristalis arbustorum* (Linnaeus, 1758)**

Material. 1♂: **12** (23.vii.2016); 1♂: **18** (24.vi.2008); 1♂: **28** (10.vii.2016); 1♂, 1♀: **30** (09.vii.2016); 1♀: **34** (25.vii.2009); 1♀: **77** (26.vii.2016); 2♂♂: **81** (9-13.vi.2015); 2♀♀: **82** (24.vi.2016); 1♂, 1♀: **84** (24.vi.2016); 1♂: **85** (30.vii.2016); 1♂: **86** (24.vi.2016).

Distribution. Whole Palearctic, including north Africa; North America; to north of India.

****Eristalis cryptarum* (Fabricius, 1794)**

Material. 1♀: **34** (21.v.2016). (Fig. 4)

Distribution. From Ireland through central Europe to central Siberia.

***Eristalis horticola* (De Geer, 1776)**

Material. 1♂: **11** (1.vii.2009); 1♂: **18** (21.vi.2008); 1♂: **34** (11.v.2015); 1♀: **37** (15.v.2016).

Distribution. From Fennoscandia toward south to North Africa; from Ireland toward east in most of Europe and Russia to the Pacific coast.

***Eristalis interrupta* (Poda, 1761)**

Material. 2♀♀: **1** (9.viii.2008, 26.ix.2009); 1♀: **3** (29.vi.2013); 1♀: **5** (19.vii.2008); 2♂♂: **12** (26.v.2013); 1♀: **14** (2.viii.2015); 1♂, 1♀: **22** (3.ix.2009); 1♀: **23** (19.vii.2014); 1♂: **24** (7.v.2016); 1♂: **26** (19.v.2009); 1♂: (10.viii.2014); 1♀: **30** (09.vii.2016); 2♂♂, 3♀♀: **34** (25.vii.2009, 17.viii.2013); 1♂: **40** (13.vii.2014); 1♂: **41** (16.viii.2015); 1♂: **46** (29.v.2016); 1♀: **76** (7.vi.2014); 1♀: **78** (18.viii.2016); 1♂, 2♀♀: **81** (9.vi.2009, 22.viii.2008).

Distribution. From northern Fennoscandia to the south, from Ireland to east through Central Europe to Turkey and Asia, to Siberia; Japan and North America.

****Eristalis intricaria* (Linnaeus, 1758)**

Material. 1♂: **35** (10.v.2016); 1♀: **78** (18.viii.2016); 1♀: **81** (1.v.2001).

Distribution. From Ireland through northern and central Europe to eastern Siberia.

***Eristalis rupium* Fabricius, 1805**

Material. 1♀: **3** (29.vi.2013); 2♀♀: **15** (2.viii.2015); 1♀: **18** (24.vi.2008); 5♀♀: **34** (9.v.2009, 12.vi.2012, 25.vii.2009); 2♂♂, 2♀♀: **35** (10.v.2014); 1♀: **37** (15.v.2016); 1♀: **54** (28.viii.2014); 1♀, 2♂♂: **63** (11-25.v.2015); 1♀: **65** (21.vii.2012).

Distribution. From Fennoscandia towards south to the Pyrenees and northern Spain; from Great Britain to the east through central Europe and Turkey, through Siberia; North America.

***Eristalis tenax* (Linnaeus, 1758)**

Material. 1♀, 2♂♂: **1** (21-27.viii.2009); 1♀: **3** (29.vi.2013); 2♀♀: **6** (27.viii.2016); 1♂: **7** (27.viii.201); 2♂♂: **12** (23.vii.2016); 1♂: **15** (2.viii.2015); 1♂: **18** (22.ix.2008); 1♀: **25** (27.viii.2016); 1♂: **28** (10.vii.2016); 1♂, 1♀: **30** (09.vii.2016); 1♀: **33** (6.ix.2014); 1♂, 2♀♀: **44** (22.vi.2013); 1♂: **50** (18.vii.2015); 1♂: **64** (10.viii.2015); 1♂: **86** (11.viii.2013); 1♂: **75** (18.vii.2015); 1♂, 3♀♀: **81** (28.vii.2016); 1♀: **84** (24.vi.2016).

Distribution. Cosmopolitan, distributed in all regions except the Far North.

***Eupeodes corolla* (Fabricius, 1794)**

Material. 1♀: **23** (19.vii.2014).

Distribution. From Iceland toward south to Iberia, the Mediterranean; North Africa; from Ireland eastwards through most of Europe into European parts of Russia; through Siberia from the Urals to the Pacific coast; Japan; China.

****Eupeodes lapponicus* (Zetterstedt, 1838)**

Material. 1♀: **18** (20.vi.2008); 1♀: **33** (3.v.2008); 2♀♀: **50** (25.v.2015); 2♀♀: **51** (31.v.2015); 1♂: **63** (13.vi.2016).

Distribution. From Ireland east through most of Eurasia (including Turkey) to the Pacific coast; Iceland; Greenland; North America.

****Eupeodes luniger* (Meigen, 1822)**

Material. 1♂: **10** (22.v.2008); 1♂: **18** (15.v.2008); 1♀: **34** (9.v.2009); 1♀: **36** (18.v.2014).

Distribution. From Ireland through Europe to the Pacific coast (Kuril Isles) and Japan.

****Ferdinandea cuprea* (Scopoli, 1763)**

Material. 1♂, 1♀: **34** (12.vii.2008); 1♂: **36** (18.v.2014).

Distribution. From Ireland through Europe to the Pacific coast (Kuril Isles) and Japan.

****Hammerschmidtia ferruginea* (Fallen, 1817)**

Material. 1♀: **65** (23.vi.2013). (Fig. 5).

Distribution. From Fennoscandia towards south to north France; from Great Britain toward east through northern and central Europe, through Siberia to the Pacific coast.

***Helophilus affinis* Wahlberg, 1844**

Material. 1♂: **59** (17.viii.2014); 1♀: **64** (30.vi.2014).

Distribution. From Scandinavia towards south to the Netherlands; through northern Europe, Siberia and Asia.

****Helophilus hybridus* Loew, 1846**

Material. 1♂: **34** (11.vii.2012); 1♀: **25** (29.v.2008); 1♀: **1** (10.v.2008); 3♀♀: **60** (24.viii.2016); 1♀: **81** (28.vii.2016).

Distribution. From Fennoscandia to north France; from Ireland toward east through central and northern Europe to Russia, then to Siberia and the Pacific coast; Serbia, Mongolia; North America from Alaska to Utah.

***Helophilus pendulus* (Linnaeus, 1758)**

Material. 1♀: **1** (21.viii.2008); 1♀: **6** (27.viii.2016); 1♀: **13** (23.vii.2016); 1♀: **21** (8.ix.2009); 1♀: **25** (29.v.2008); 1♀: **29** (7.viii.2013); 1♂: **33** (30.v.2008); 1♂, 1♀: **34** (17.viii.2013, 19.v.2013); 1♂: **43** (12.vii.2014); 1♀: **56** (24.vii.2016); 1♂, 1♀: **60** (24.vii.2016); 1♀: **80** (6.vi.2008).

Distribution. From Iceland south to Iberia; from Ireland to the east through central and southern Eurasia to the Pacific coast.

****Helophilus trivittatus* (Fabricius, 1805)**

Material. 1♀: **18** (24.vi.2008); 1♀: **6** (12.vi.2015); 1♀: **34** (21.v.2016); 1♀: **57** (27.v.2016); 1♀: **68** (10.viii.2016); 1♂: **73** (18.vii.2015); 1♀: **77** (26.vii.2016).

Distribution. From Fennoscandia toward south to the Mediterranean Sea; Ireland through Eurasia to the Pacific coast; Iran, Afghanistan.

****Leucozona glaucia* (Linnaeus, 1758)**

Material. 1♂: **63** (13.vi.2016); 1♂: **67** (14.vi.2016).

Distribution. From Ireland through mountainous parts of central Europe into Turkey and European parts of Russia; from Siberia to the Pacific coast.

****Leucozona inopinata* Doczkal, 2000**

Material. 1♀: **10** (22.v.2008).

Distribution. Norway, Sweden, Finland, Denmark, Germany, France, Switzerland, Austria, Hungary, Japan.

****Leucozona laternaria* (Müller, 1776)**

Material. 1♀: **18** (24.vi.2008).

Distribution. From Ireland through Europe to the Pacific coast and Japan.

****Mallota megilliformis* (Fallen, 1817)**

Material. 1♀: **2** (20.v.2008); 1♀: **25** (02.vi.2009); 1♀: **31** (25.v.2013); 1♀: **33** (19.v.2016); 1♂: **67** (21.v.2016); 1♂: **68** (10.vi.2016).

Distribution. From south of Fennoscandia to Germany; from Poland towards the east to European part of Russia to Siberia and Khabarovsk.

****Mallota rossica* Portschinsky, 1877**

Material. 1♂: **63** (8.vi.2014). (Fig. 6).

Distribution. The central part of European Russia, Iran, Kyrgyzstan; from Asiatic part of Russia to Sakhalin; Mongolia, China.

***Mallota tricolor* Loew, 1871**

Material. 1♀: **34** (21.v.2016); 1♂: **54** (11.vi.2016). (Fig. 7).

Distribution. Lithuania, Poland, Germany, Belarus, European parts of Russia and Asia; Siberia to Kamchatka.

***Melanostoma mellinum* (Linnaeus, 1758)**

Material. 1♀: **26** (19.v.2013); 1♂: **33** (5.v.2013).

Distribution. Norway, Finland, Luxembourg, France, European part of Russia.

***Microdon analis* (Macquart, 1842)**

Material. 2♀♀: **31** (6.vi.2015); 1♀: **35** (10.vi.2012); 1♂: **51** (31.v.2015); 1♀: **53** (11.vi.2016); 1♀: **56** (14.vi.2016); 1♀: **57** (27.v.2016); 1♂, 2♀♀: **60** (31.v.2015); 1♀: **62** (3.v.2016); 2♀♀: **63** (29.v.2015).

Distribution. From Ireland through most of Europe to the Pacific coast; Mongolia.

****Microdon mutabilis* (Linnaeus 1758)**

Material. 1♂: **25** (29.v.2008); 1♀: **44** (5.vi.2009); 1♀: **60** (7.vi.2015); 1♂: **63** (8.vi.2014).

Distribution. From Ireland through most of Europe to the Pacific coast.

***Myathropa florea* (Linnaeus, 1758)**

Material. 1♀: **40** (13.vii.2014); 1♂: **60** (7.vi.2015); 1♀: **63** (13.vi.2016).

Distribution. From Fennoscandia towards the south to Iberia and Mediterranean, the Canary Islands and in North Africa; from Ireland toward east through Eurasia to the Pacific coast.

****Myolepta vara* (Panzer, 1798)**

Material. 1♂: **22** (5.vi.2009).

Distribution. From the Netherlands through Belgium toward south, to the Mediterranean Sea; through central and southern Europe to Switzerland; Austria, Romania, the Balkans and the Caucasus, to the Pacific coast.

****Paragus bicolor* (Fabricius, 1794)**

Material. 1♀: **3** (8.vi.2013).

Distribution. From southern Sweden and Denmark toward south to the Mediterranean and northern Africa; from France toward east through central and southern Europe to Mongolia; Iran and Afghanistan; North America.

***Parhelophilus frutetorum* (Fabricius, 1775)**

Material. 1♂: **52** (27.v.2016). (Fig. 8).

Distribution. From Southern Sweden through central Europe into Russia, the Caucasus and eastern Siberia.

****Pipiza lugubris* (Fabricius, 1775)**

Material. 1♀: **13** (19.vii.2015); 1♀: **46** (18.vi.2016); 1♀: **58** (9.viii.2014).

Distribution. Fennoscandia, Poland, from England through France and across central Europe to Austria.

****Pipiza nocticula* (Linnaeus, 1758)**

Material. 1♀: **34** (21.v.2016); 1♀: **50** (31.v.2016).

Distribution. Europe.

***Platycheirus albimanus* (Fabricius, 1781)**

Material. 1♀: **35** (16.v.2015); 1♀: **58** (9.viii.2014).

Distribution. Greenland, Iceland, from Fennoscandia toward south to Iberia and the Mediterranean; from Ireland through most of Europe into Turkey and European part of Russia; from the Urals to the Pacific coast; Philippines; western parts of the USA.

****Platycheirus podagratus* (Zetterstedt, 1838)**

Material. 1♂: **31** (25.v.2013); 1♂: **33** (5.v.2013).

Distribution. From Fennoscandia to the Pyrenees; from Ireland through northern Europe and mountainous parts of central Europe into Russia to Siberia; North America.

****Platycheirus rosarum* (Fabricius, 1787)**

Material. 1♀: **48** (13.viii.2015).

Distribution. From Fennoscandia to Iberia and the Mediterranean; from Ireland through most of Europe to European parts of Russia; from the Urals to the Altai; in North America from Alaska to Nova Scotia and south to New Jersey.

****Psarus abdominalis* (Fabricius, 1794)**

Material. 1♀: **44** (5.vi.2009).

Distribution. From Sweden through the Netherlands to central France; from Brittany through central Europe to European part of Russia.

****Rhingia campestris* Meigen, 1822**

Material. 1♀: **18** (21.vi.2008); 1 ♀: **25** (02.vi.2009).

Distribution. From Fennoscandia to the Pyrenees, northern Spain and the Mediterranean; from Ireland through most of Europe to European parts of Russia and the Caucasus; throughout Siberia to the Pacific coast; Mongolia.

***Sericomyia silentis* (Harris, 1776)**

Material. 1♀: **34** (12.viii.2008); 1 ♂: **43** (4.viii.2015); 1♂: **51** (22.viii.2015); 1♀: **63** (22.viii.2015); 1 ♂: **65** (7.vii.2014).

Distribution. From Fennoscandia through mountainous regions to the Pyrenees; from Ireland through northern Europe and mountainous parts of central Europe to Russia and the Pacific coast and Japan.

***Sphaerophoria scripta* (Linnaeus, 1758)**

Material. 1♂: **15** (2.viii.2015); 2♂♂, 1♀: **18** (24-25.vi.2008); 1♀: **21** (8.ix.2009); 1♂: **27**

(11.v.2008); 1♂: **31** (25.v.2013); **32** (6.viii.2013); 1♂: **34** (1.viii.2012); 1♂: **37** (20.v.2015); 1♂: **51** (31.v.2015).

Distribution. From Iceland and Fennoscandia to the Mediterranean and north Africa; from Ireland through much of the Palearctic to the Pacific coast (United Kingdom, Ireland, Italy, Spain, Austria, Denmark, Czech Republic, Finland, France, Germany, Greece, Greenland, Iceland, Norway, Sweden, Switzerland, Belarus).

***Sphecomyia vespiformis* (Gorski, 1852)**

Material. 1♂: **25** (29.v.2008); 1♂: **81** (9.vi.2009).

Distribution. From Norway to northern Sweden, Finland and Karelia, Poland and Siberia.

***Spilomyia diophthalma* (Linnaeus, 1758)**

Material. 3♀♀: **34** (11.v.2015, 8.vii.2012, 17.viii.2013); 1♂: **41** (15.viii.2014); 1♀: **60** (24.vii.2016); 1♂: **66** (18.viii.2013); 1♂: **75** (2.viii.2014); 1♂: **81** (21.vi.2009).

Distribution. Southern Norway, Sweden, Finland, Germany, Czech Republic, France, Switzerland, northern Italy, European parts of Russia, Turkey and the Caucasus and on through Siberia to Sakhalin.

****Syritta pipiens* (Linnaeus, 1758)**

Material. 1♂: **1** (26.v.2009); 1♀; 1♂: **42** (17.vi.2015); 2♂♂, 1♀: **44** (22.vi.2013).

Distribution. Most of the Palearctic, including north Africa (Austria, Belarus, Czech Republic, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Mexico, Norway, Spain, Sweden, Switzerland, United Kingdom); most of North America, South America and the Oriental region.

***Syrphus ribesii* (Linnaeus, 1758)**

Material. 2♀♀: **1** (9.viii.2008); 1♂: **26** (19.v.2009); 1♀: **31** (25.v.2013); 1♂: **33** (19.v.2016); **34** (21.v.2016); 1♀: **37** (15.v.2016); 1♂, 1♀: **49** (14.v.2016); 1♂, 1♀: **57** (27.v.2016); 1♀: **60** (18.v.2014); 1♀: **70** (13.viii.2016); 1♀: **82** (26.vi.2016).

Distribution. From Iceland to Iberia and the Mediterranean; from Ireland through most of Europe to Turkey, European parts of Russia and Afghanistan; from the Urals to the Pacific coast; Japan; from Alaska south to central parts of the USA.

***Syrphus vitripennis* Meigen, 1822**

Material. 2♀♀: **1** (9.viii.2008, 29.ix.2009); 1♂: **4** (18.v.2008); 1♀: **18** (18.vi.2015); 1♂: **21** (8.ix.2009); 1♂: **25** (29.v.2008); 2♀♀, 1♂: **33**

(3-19.v.2013); 1♂, 2♀♀: **34** (11-21.v.2015); 1♀, 1♂: **37** (15.v.2016); 1♂: **49** (14.v.2016); 2♀♀, 2♂♂: **72** (11.v.2016); 1♀: **74** (18.vii.2015); 1♂: **80** (6.vi.2008).

Distribution. Most of the Palearctic region, including north Africa (Austria, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom); United States, Canada, Japan.

***Temnostoma apiforme* (Fabricius, 1794)**

Material. 1♂: **34** (1.vii.2012); 1♂: **42** (18.vi.2015); 1♂: **50** (25.v.2015); 1♂: **51** (31.v.2015); 1♂: **52** (27.v.2016); 1♂: **56** (28.v.2016); 2♂♂: **60** (31.v.2015, 11.vi.2016); 1♂: **63** (25.v.2015); 1♂: **65** (12.vi.2016); 1♀: **71** (26.v.2015).

Distribution. From Lapland to northern France; from eastern Belgium through northern and central Europe to European parts of Russia and through Siberia to the Pacific coast and Japan.

***Temnostoma bombylans* (Fabricius, 1805)**

Material. 1♀: **7** (5.vi.2016); 1♂: **19** (12.vi.2008); 1♀: **33** (30.v.2008); 1♂, 1♀: **37** (29.v.2016); 1♀: **60** (7.vi.2015); 1♂: **63** (8.vi.2014); 1♂: **66** (5.vi.2015); 1♀: **80** (06.vi.2008).

Distribution. From Sweden and Denmark south to the Pyrenees and North Africa; from northern France through northern and central Europe to Asiatic parts of Russia, the Pacific coast and Japan; Korea.

***Temnostoma vespiforme* (Linnaeus, 1758)**

Material. 1♀: **1** (28.vii.2011); 1♂: **18** (27.vi.2008); 1♀: **46** (29.v.2016); 1♀: **52** (21.vi.2015); 1♂: **54** (21.vii.2013); 1♀, 1♂: **60** (7.vi.2015, 13.viii.2015); 1♂, 1♀: **63** (7.vi.2015); 1♂: **67** (13.viii.2016); 1♂: **72** (5.vi.2015); 1♀: **74** (18.vii.2015); 1♂: **80** (6.vi.2008).

Distribution. From Sweden to Spain; from France through most of Europe and on through Asiatic parts of Russia to the Pacific coast and Japan; the Caucasus; from Alaska to New Mexico.

****Trichopsomyia flavitarsis* (Meigen, 1822)**

Material. 1♂: **31** (25.v.2013).

Distribution. From Fennoscandia to the Pyrenees; from Ireland through northern Europe and mountainous parts of central Europe into European parts of Russia and on to the Pacific coast.

***Volucella bombylans* (Linnaeus, 1758)**

Material. 1♂: **6** (5.vi.2016); 2♀♀: **7** (5.vi.2016); 1♂: **9** (9.vii.2009); 1♀: **16** (30.v.2008); 7♂♂: **18** (5-24.vi.2008); 1♂: **27** (16.viii.2008); 1♂: **28** (10.vii.2016); 1♀: **31** (6.vi.2015); 2♂♂: **33** (22.vi.2014); 4♂♂: **34** (8-13.vi.2014, 25.vii.2009); 1♂: **37** (25.v.2014); 1♂: **42** (18.vi.2016); 1♂, 2♀♀: **51** (31.v.2015, 06.vi.2012); 1♂: **52** (27.v.2016); 1♀: **56** (14.vi.2016); 1♂: **57** (27.v.2016); 1♀: **60** (7.vi.2015); 1♂: **62** (3.vi.2016); 3♂♂: **63** (13.vi.2016); 1♀: **64** (16.vi.2014); 1♂♂, 2♀♀: **66** (31.v.2015); 1♂, 1♀: **68** (10.vi.2016); 2♀♀: **69** (2.vi.2016); 1♂: **70** (26.v.2016); 1♀: **74** (7.vi.2014); 1♀: **76** (7.vi.2014); 1♂, 1♀: **77** (21.vi.2016); 2♂♂: **84** (24.vi.2016); 1♂, 1♀: **85** (24.vi.2016).

Distribution. From Fennoscandia to Iberia; from Ireland through central and southern Europe into Russia to the Pacific coast and Japan; from Alaska to Newfoundland and south to California and Georgia.

***Volucella inanis (Linnaeus, 1758)**

Material. 2♀♀: **1** (20.vii.2008, 9.viii.2008); 1♀: **27** (16.viii.2008); 1♂: **29** (7.viii.2013); 1♂: **40** (13.vii.2014).

Distribution. From Fennoscandia to Spain and the Mediterranean; north Africa and Asia Minor (Syria); from Britain through central and southern Europe to Turkey and European parts of Russia and the Pacific; Afghanistan, Mongolia, China.

***Volucella infata (Fabricius, 1794)**

Material. 1♀: **37** (15.v.2016).

Distribution. From Sweden to the Pyrenees; from Britain through central Europe to European parts of Russia and the Caucasus.

Volucella pellucens (Linnaeus, 1758)

Material. 1♀: **1** (9.viii.2008); 1♀: **3** (10.viii.2014); 1♀: **9** (18.vii.2009); 1♀: **14** (2.viii.2015); 1♀: **15** (2.viii.2015); 1♀: **18** (27.vi.2008); 1♀: **21** (8.vii.2008); 1♀: **27** (16.viii.2008); 1♀: **34** (1.viii.2015); 1♀: **45** (10.viii.2014); 1♀: **50** (22.viii.2015); 1♂: **53** (11.vi.2016); 1♂: **65** (12.vi.2016); 1♀: **70** (13.vi.2015); 1♂: **74** (18.vii.2015).

Distribution: From Fennoscandia to Iberia; from Ireland through Eurasia to Japan; India.

***Xanthandrus comtus (Harris, 1780)**

Material. 1♀: **22** (3.ix.2009).

Distribution. From Ireland through central and southern Europe to Russia and the Caucasus and on to the Pacific coast; Japan.

***Xanthogramma citrofasciatum (De Geer, 1776)**

Material. 1♂: **8** (31.v.2015); 1♀: **51** (31.v.2015).

Distribution. From Norway to Iberia; from Ireland through central and southern Europe to European Russia; the Caucasus; western Siberia.

***Xanthogramma pedissequum (Harris, 1776)**

Material. 1♂: **23** (19.vii.2014); 1♀: **25** (2.vi.2009); 1♂: **27** (11.v.2008); 1♂: **31** (6.vi.2015); 1♂: **44** (22.vi.2013); 1♂: **46** (29.v.2016).

Distribution. From Britain to southern France and into central Europe.

***Xylota abiens Meigen, 1822**

Material. 1♀: **18** (5.vii.2008); 1♀: **33** (1.vii.2014); 1♀: **47** (28.vii.2015); 1♂: **57** (27.v.2016).

Distribution. From Denmark to the Pyrenees; from Ireland through central Europe to Russia, the Caucasus and the Pacific coast.

***Xylota florum (Fabricius, 1805)**

Material. 1♂: **57** (27.v.2016).

Distribution. From Ireland through much of Europe into European parts of Russia and the Caucasus and on as far as eastern Siberia.

Xylota segnis (Linnaeus, 1758)

Material. 1♂: **35** (10.vi.2012); 1♀: **44** (5.vi.2009); 1♂: **63** (13.vi.2016).

Distribution. Europe except for the extreme north.

Xylota sylvarum (Linnaeus, 1758)

Material. 1♂: **35** (10.vi.2012); 1♀: **61** (01.vii.2016).

Distribution. From Fennoscandia to Iberia; from Ireland through much of northern and central Eurasia to the Pacific coast; Greece and Turkey.

***Xylota tarda Meigen, 1822**

Material. 1♀: **56** (17.vi.2014).

Distribution. From Fennoscandia to Spain; from Ireland through central Europe into European parts of Russia; the Caucasus; through Asia to the Pacific coast.

***Xylota triangularis Zetterstedt, 1838**

Material. 1♀: **18** (17.vi.2008).

Distribution. From Lapland to Norway and Sweden; European parts of Russia and Siberia; Mongolia.



Fig. 3. *Blera fallax* L., lateral view.



Fig. 4. *Eristalis cryptarum* F., lateral view.



Fig. 5. *Hammerschmidtia ferruginea* F., lateral view.



Fig. 6a. *Mallota rossica* P., lateral view.

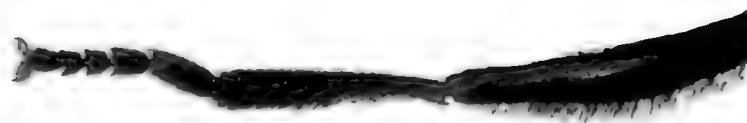


Fig. 6b. *Mallota rossica* P., fore leg.



Fig. 7. *Mallota tricolor* L., lateral view.



Fig. 8. *Parhelophilus frutetorum* F., lateral view.

Discussion

To discuss the data presented here, it is necessary to note the following. Of the 103 provided species, 43 species were recorded for the Republic of Mordovia earlier. Namely, *C. conopoides*, *Ch. piger*, *Ch. albitarsis*, *Cr. asilica*, *Cr. ranunculi*, *D. venustus*, *E. balteatus*, *E. aeneus*, *E. abusive*, *E. horticola*, *H. affinis*, *M. tricolor*, *M. mellinum*, *M. analis*, *M. florea*, *P. frutetorum*, *Pl. albimanus*, *S. silentis*, *Sph. vespiformis*, *Sp. diophthalma*, *T. vespiforme*, *T. apiforme*, *T. bombylans*, *V. bombylans*, *X. sylvarum* were recorded for the region by Feoktistov (2011), *Ch. nemorum*, *Ch. mutabilis*, *Ch. bicinctum*, *E. grossulariae*, *E. arbustorum*, *E. tenax*, *E. rupium*, *S. vitripennis*, *X. segnis* were recorded for the region by Plavilshchikov (1964), *Ch. festivum*, *E. interraptia*, *H. pendulus* were recorded by Plavilshchikov (1964), Antsiferova and Dobromyslov (1966). *E. corolla* was recorded for the region by Plavilshchikov (1964), Antsiferova (1966) and in The Red Data Book (Astradamov, 2005). *Sph. scripta* was recorded for the region by Plavilshchikov (1964), Antsiferova *et al.* (1966) and Antsiferova (1979). *S. ribessi* was recorded for the region by Plavilshchikov (1964) and Antsiferova (1979). *V. pellucens* was recorded for the region by Plavilshchikov (1964), Ruchin *et al.* (2007), Ruchin (2008) and Feoktistov (2011).

The most widespread species in the studied region are species from the genera *Volucella*, *Chrysotoxum*, *Syrphus* and *Eristalis*. These species were recorded for the region in previous studies and are represented in most of the studied habitats. Some recorded species, including *Ch. festivum*, *V. bombylans*, *E. aeneus*, *E. tenax* are widespread or cosmopolitan, but their new distributional record from Mordovia are of importance. These data reflect an important role of this species for forest ecosystems functioning. Thus, a wide range of ecological tolerance allows them to be widely distributed in a variety of habitats.

A number of species, such as *E. lapponicus*, *M. rossica*, *E. diaphana*, *X. comtus*, species of the genus *Cheilosia* and some others, are rare and were recorded for

the territory of Mordovia State Nature Reserve for the first time.

Speaking of rare species, it is important to note such species as *Criorhina ranunculi*. It is a Central European nemoral species, which is distributed from South Ukraine to Leningrad Region. It is known as a relict species and has been recorded in the areas, which were defined as Quaternary refuges. Adults can be found in April and May, visiting blooming willow. Larvae develop in rotting wood and hollows of old decaying trees, mainly deciduous trees. Thus, reduction of the areas of natural deciduous forests is a limiting factor, restricting a distribution of this species. *E. cryptarum* is a very rare boreal species, which prefers wetland, spring-fed streamlets in tundra, floodplain marshes and wet flushes in moorland. Larvae are detritus feeders, developing in water (Speight, 2002).

Typical inhabitants of light sparse forests, forest with overmature trees and forest borders are species belonging to genera *Brachypalpus*, *Chalcosyrphus* and *Xylota*. These species are associated with trees and shrubs, and their larvae have been found in xylem. It is noticeable that among recorded species there were extremely anthropophilic species occurring in farmlands, gardens and parks, along fire-breaks and tracks, such as *P. albimanus*, *S. scripta*, *S. pipiens*, *X. segnis*, *S. ribessi* and *S. vitripennis*.

We have presented a comprehensive revision of the syrphid fauna, based on long-term collection. This source of information can be considered by future ecological and faunistic researches. Such study may provide a wider review of the dynamics of diptera fauna populations, which associated with ecosystem changes.

References

- Antsiferova, T.A. 1966. An effect of sowing of different standards of phacelia to pears and fodder beans on the insect fauna composition and yield of main crops. In: T.A. Antsiferova (ed.) *Ecological and faunistic relations of some groups of*

- invertebrates and vertebrates*. Mordovia Book Publishing House, Saransk: 7–28 (in Russian).
- Antsiferova, T.A. 1979. Entomocoenosis of lucerne and its sowing efficiency. Ecological and faunistic studies in the non-blackearth zone of the RSFSR 2: 144–150 (in Russian).
- Antsiferova, T.A. and Dobrosmyslov, P.A. 1966. Entomofauna of vico-oat-lucerne and vico-oat mixture in Mordovian ASSR. In: T.A. Antsiferova, (ed.) *Ecological and faunistic relations of some groups of invertebrates and vertebrates*. Mordovia Book Publishing House, Saransk: 64–81 (in Russian).
- Antsiferova, T.A., Dobrosmyslov, P.A. and Makarov, A.T. 1966. Some data on the insect fauna on the crops of fodder beans. In: Antsiferova, T.A. (ed.) *Ecological and faunistic relations of some groups of invertebrates and vertebrates*. Mordovia Book Publishing House, Saransk: 29–52 (in Russian).
- Anufriev, G.A. and Soshnikov, V.I. 1984. Fauna of syrphid flies of Gorky Region. In: *Terrestrial and aquatic ecosystems*. Gorky: 65–75 (in Russian).
- Astradamov, V.I. 2005. Red Data Book of Mordovia Republic. Volume 2: Animals. Saransk: 1–336 (in Russian).
- Belova, Y.N., Dolganova, M.N., Kolesova, N.S. and Shabunov, A.A. 2008. Diversity of insects of the Vologda region. Vologda: Center of operative printing "Kopernik". 38pp.
- Fauna Europea 2000–2015. All European animal species online. Accessed online at <http://www.fauna-eu.org/>
- Feoktisev, V.F. 2011. List of insect species, first noted in the Mordovia reserve and in adjacent territories. Bulletin of Mordovia University, Biological Sciences 4: 83–89 (in Russian).
- Kevan, N.G. and Baker, H.G. 1983. Insects as flower visitors and pollinators. Annual Review of Entomology 28: 407–453.
- Miranda, G.F.G., Young, A.D., Locke, S.A., Skevington, J.H. and Thompson, F.C. 2013. Key of the Genera of Nearctic Syrphidae. Canadian Journal of Arthropod Identification 23: 1–351.
- Mutin, V.A. and Barkalov, A.V. 1997. A review of the Hoverflies (Diptera: Syrphidae) of Sakhalin and Kuril Islands, with descriptions of two new species. Species Diversity 2: 179–230.
- Pestov, S.V. 2010. Seasonal dynamics of hoverfly (Diptera, Syrphidae) activity in the taiga zone of the Komi Republic. Entomological review 90: 718–723.
- Pestov, S.V., Yuferov, G.I. and Tselishcheva, L.G. 2010. Hoverfly (Diptera, Syrphidae) from Kirov Region. Bulletin of the Udmurt University 4: 86–96 (in Russian).
- Plavilshnikov, N.N. 1964. List of insect species found on the territory of the Mordovian State Reserve. Proceedings of the Mordovia State Nature Reserve 2: 105–134 (in Russian).
- Ruchin, A.B. 2008. List of insect species of the National Park "Smolny". Scientific papers of Smolny National Park 1: 151–180 (in Russian).
- Ruchin, A.B. and Egorov, L.V. 2017. Overview of insect species included in the Red Data Book of Russian Federation in the Mordovia State Nature Reserve. Nature Conservation Research 2(Suppl. 1): 2–9. DOI: 10.24189/ncr.2017.016 (in Russian).
- Ruchin, A.B., Loginova, N.G. and Kurmaeva D.K. 2007. To the insect fauna of two forestry of the National Park "Smolny". Fauna and ecology of insects 1: 24–33 (in Russian).
- Sommaggio, D. 1999. Syrphidae: can they be used as environmental bioindicators? Agriculture, Ecosystems and Environment 74: 343–356.
- Sorokina, V.S. 2006. Latitudinal distribution of syrphid flies (Diptera) in the territory of the southern sub-

- Urals. Eurasian Entomological Journal 5: 69–76 (in Russian).
- Sorokina, V.S. and Chashchina, O.E. 2003. Data on the fauna of flower flies (Diptera: *Syrphidae*) of the South Urals. Russian Entomological Journal 12: 93–101.
- Speight, M.C.D. 2002. An annotated list of the *Syrphidae* (Diptera) of Pollardstown Fen, Co. Kildare, Ireland. Bulletin Irish biogeographical Society 26: 196–210.
- Speight, M.C.D. 2014. Species accounts of European *Syrphidae* (Diptera). *Syrph the Net*, the database of European *Syrphidae*. Vol. 78. 321 pp.
- Stackelberg, A.A. 1933. Family *Syrphidae*. In: *Key to Flies of the European Part of USSR*. Publishing house of the Academy of Sciences of the USSR, Leningrad: 219–278 (in Russian).
- Stackelberg, A.A. 1958. Materials on the fauna of Diptera of Leningrad Region. Proceedings of the Zoological Institute Academy of Sciences 24: 192–246 (in Russian).
- Stackelberg, A.A. 1970. Family *Syrphidae*. In: *Keys to the Insects of the European Part of the USSR*. Vol. 5. Dipterans, fleas. Part II. Leningrad, 11–96 (In Russian).
- Thompson, F.C. and Vockeroth, J.R. 1989. 51. Family *Syrphidae*. In: *Catalog of the Diptera of Australia and Oceania*. Honolulu: 437–458.
- Vockeroth, J.R. and Thompson, F.C. 1987. *Syrphidae*. In: *Manual of Nearctic Diptera*. Vol. 2. Ottawa: 713–748.
- Yamashkin, A.A. 2014. Physical Geography of Mordovia: maps, pictures, photographs and figures. Saransk: Mordovia State University Press, 1–162. (in Russian.)
- Zimina, L.V. 1957. New data on ecology and fauna of the family *Syrphidae* (Diptera). Moscow Society of Naturalists. Biological series 62: 51–62 (in Russian).
- Zimina, L.V. 1981. The rare and interesting species of the family *Syrphidae* (Diptera) in the collection of MSU museum. 2. Proceedings of the Zoological Museum of Moscow State University 19: 150–170 (in Russian).
- Zimina, L.V. 1986. An additional data on fauna of syrphid flies (Diptera, *Syrphidae*) of Moscow Region. Bulletin of Moscow Society of Naturalists. Biological series. 91: 55–58 (in Russian).

A new genus of Heteromurini (Collembola: Entomobryidae) with dental base falcate macrochaetae, from India

Guru Pada Mandal

Zoological Survey of India, Apterygota Section, M-Block, New Alipore, Kolkata- 700053, India.

(Email: gpmandal.zsi@gmail.com)

Abstract

A new monotypic genus of Heteromurinae from Chilika lake, Ganjam district of Odisha, India is described. *Falcomurus* gen. n. is similar to other genera of the subfamily, especially to *Heteromurus* Wankel, 1860 in presence of antennae with 5 segments, 8 + 8 eyes, Abd. I without macrochaetae. It differs from all other genera of Heteromurinae by the combination of: eyes 8 + 8, Ant. III and Ant. IV annulated, unguis with single paired basal inner teeth, dental base commonly with 1+1 falcate type macrochaetae. *Falcomurus chilikaensis* sp. n., the type species of the new genus is described. An identification key to the genera of Heteromurini is also provided.

Keywords: *Collembola*, *Heteromurini*, new genus, new species, Chilika, India.

Received: 24 July 2017; Revised: 31 May 2018; Online: 1 June 2018.

Introduction

Heteromurini Absolon & Ksenemann, 1942 is a tribe of entomobryids widely distributed in the world and highly diverse in the tropics, currently with about 127 described species (Bellinger *et al.*, 1996-2017).

Heteromurini species are distinguished from other tribes by the presence of strongly striated apically rounded or truncate scales on body and five antennal segments (Mari Mutt, 1980a), but other current classification suggests that some members of the tribe are devoid of scales (Soto-Adames *et al.*, 2008). However, Zhang *et al.* (2014) recently proposed a new classification for Heteromurini, suggesting these characteristics appeared independently from other Entomobryidae and therefore added *Dicranocentrus* Schött, 1893 and *Pseudodicranocentrus* Mari Mutt, 1981 (in:1981b) in Heteromurini (Zhang *et al.*, 2014; Zhang & Deharveng, 2015). *Heteromurus* Wankel, 1860 is the type genus of Heteromurini, with 17 described species widely distributed (Cipola *et al.*, 2016). Pantropical taxa *Alloscopus* Börner, 1906, *Heteromurtrella* Mari

Mutt, 1979 (in: 1979b) and *Verhoeffiella* Absolon, 1900 restricted to Africa and Europe, are ambiguously considered as: generic levels of Heteromurini (Thibaud & Massoud 1973; Hopkin 1997; Soto-Adames *et al.*, 2008); or subgenera of *Heteromurus* (Mari Mutt, 1977, 1980a, b; Lučić *et al.*, 2007, 2008).

Heteromurini species are diagnosed by Ant. with 5 (Ant. I subdivided in Ia and Ib) or 6 segments (Ant. II also subdivided in IIa and IIb), Ant. III–IV annulated or not; eyes 0+0 to 3+3, 6+6 or 8+8; PLQ with 2+2 chaetae; PAO present or absent (more common); head dorsal macrochaetotaxy with or without mac in series postsutural (Ps) and postoccipital (Pa, Pm and Pp); body dorsal mac reduced (e.g. *Heteromurus* s. lat.) or relatively dense (e.g. *Dicranocentrus* and *Pseudodicranocentrus*); Abd. II–IV bothriotricha formula 2, 3, 2; Th. II to Abd. V with S-chaeta formula 1, 0| 1, 0, 1, 0, 0 (ms) and 2, 2| 1, 3, 3, -, 3(4); Abd. IV 1.2–1.5 times the length of Abd. III in the midline; trochanteral organ with at least 12 spine-like chaetae; dental spines present or absent; mucro bidentate with or without basal spine (Cipola *et al.*, 2016).

Heteromurini resembles other tribes of Entomobryidae as Orchesellini (Orchesellinae) and Mastigocerini (Heteromurinae) by Ant. with 5–6 segments, trochanteral organ with more than 15 chaetae, Th. II to Abd. III with S-chaeta (ms) formula 1, 0| 1, 0, 1 and mucro bidentate (Zhang & Deharveng, 2015). However the Heteromurini is distinguished from these tribes by presence of scales apically rounded or truncate on body, while in Mastigocerini scales are fusiform and in Orchesellini they are absent. Also, the chaetotaxy of tergal sensilla is 33- 3(4) in Abd. II–V of Heteromurini and Mastigocerini, while in Orchesellini the number is higher (Zhang & Deharveng, 2015).

Here a new genus and species of Heteromurini with 5 segmented antennae from Chilika Lagoon, India is described and illustrated, and an identification key to Heteromurini genera is provided.

Materials and Methods

The specimens were collected from the wet soil under the stones near the intertidal zone of the Chilika Lake, Odhisa, India, and preserved in 70% alcohol. Specimens were mounted under a cover slip in Hoyer's medium, and were studied under a Leica Digital Module (DM 2500) microscope; photographs were taken under a Leica Digital Module R (DMR) microscope using a mounted Leica DFC 295 digital Camera, and were enhanced with photoshop CS4 (Adobe Inc.). All specimens are deposited in the Apterygota section, Zoological Survey of India (ZSI), Kolkata.

Abbreviation

Ant- antennae; Abd- abdomen; Bot- bothritrichia; Mac- macrochaetae; PLQ- post labial quadrangle; PAO- post antennal organ; Th- thorax, ZSI = Zoological Survey of India, (Kolkata).

Results

Systematics

Family Entomobryidae Tomosvary, 1882

Subfamily Heteromurinae sensu Zhang & Deharveng, 2015

Tribus: Heteromurini Absolon & Ksenemann, 1942

Key to the world genera of Heteromurini (modified from Cipola *et al.*, 2016)

1. Antennae with 6 segments, Ant II subdivided (IIa and IIb); unguis with two paired basal inner teeth, never wing like....2
- Antennae with 5 segments, Ant II not subdivided; unguis with two basal inner teeth or with two basal wing-like paired teeth.....3
2. Head with A1 and Ps2 mac; prelabral chaetae bifurcate; dens base commonly with 3 groups of circularly arranged compound spines; dental spines absent.....*Pseudodicranocentrus* Mari Mutt
- Head without A1 and Ps2 mac; prelabral chaetae not bifurcate; dens base without compound spines; dental spines rows present or absent.....*Dicranocentrus* Schött
3. Ant. III not annulated.....4
- Ant. III annulated.....6
4. Abd. I with at least 1+1 mac.....5
- Abd. I without mac....*Heteromurus* Wankel
5. Posterior region of head without postoccipital mac; PAO present; dental spines always present.....*Alloscopus* Börner
- Posterior region of head with postoccipital mac; PAO absent; dental spines usually absent.....*Heteromurtrella* Mari Mutt
6. Dens base with 1+1 falcate type macrochaetae; mucronal spine absent.....*Falcomurus* gen. n.
- Dens base without 1+1 falcate type macrochaetae; mucronal spine present.....*Verhoeffiella* Absolon

Description of new genus

Falcomurus gen. n. Mandal

Type species: *Falcomurus chilikaensis* sp. n.

Diagnosis of genus:

Strongly striated apically rounded or truncate scales present on body, antennae, legs and furcula (Fig. 2). Ant. with 5 segments (Ant. I subdivided in Ia and Ib), Ant. III-IV annulated (Fig. 4); eyes 8+8; PAO absent; head dorsal macrochaetotaxy with mac in series postsutural (Ps2) and postoccipital (Fig. 6); body dorsal mac reduced; Abd. II-IV bothritrichia formula 3,3,2

(Fig. 7); unguis with single paired basal inner teeth; unguiculus broad, lanceolate type without tooth (Fig. 14); dental base with 1+1 falcate type macrochaetae (Fig. 16); dental spine absent; mucro bidendate without basal spine (Fig. 17).

Etymology

The genus was named after the falcate type of macrochaetae on dens-base and it is similar to *Heteromurus* in morphology.

Remarks

Falcomurus **gen. n.** is given generic status within the group of other *Heteromurus* - like genera because of a combination of characters. These are antennae 5 segmented, Ant. III-IV annulated, PAO absent, eyes 8+8, unguis with single paired basal inner teeth and dental base commonly with 1+1 falcate type macrochaetae. The last character is present only in this genus.

Table 1. Comparison of Heteromurini genera with 5 segmented antennae

Sl. No.	Genera	<i>Falcomurus</i> gen.nov.	<i>Heteromurus</i> Wankel, 1860	<i>Heteromurtrella</i> Mari Mutt, 1979	<i>Alloscopus</i> Borner, 1906	<i>Verhoeffiella</i> Absolon, 1900
1	Ant. IV annulated	+	+	+ or –	+	+
2	Ant. III annulated	+	–	–	–	+
3	Number of eyes	8+8	0+0 to 3+3 or 8+8	0+0 to 2+2 or 6+6	0+0 to 3+3	0+0
4	Postantennal organ	–	–	–	+	–
5	Th II central mac	11+11 to 15+15	6+6 to 9+9	7+7 to 15+15	10+10 to 13+13	7+7 to 9+9
6	Th III central mac	9+9	4+4	2+2 to 8+8	6+6 or 7+7	4+4
7	Abd. I central mac	–	–	1+1 to 3+3	3	–
8	Abd. II central mac	4+4	0 +0 to 2+2	1+1	1+1	1+1
9	Abd. III central mac	3+3	0+0 to 2+2	1+1	1+1	1+1
10	Paired basal teeth in unguis	inner	inner	Wing-like	inner	inner
11	Outer tooth in unguiculi	–	+	+ or –	+ or –	+ or –
12	Smooth setae on manubrium	+	+ or –	+	+	+
13	Dens base with macrochaetae	1+1 falcate type macrochaetae	–	–	–	–
14	Spines on dens	–	–	+ or –	+	–
15	Mucronal spine	–	+or –	+ or –	+ or –	+

Symbols used to represent the morphological characteristics: Ant.- antennae; Abd.- abdomen; mac-macrochaetae; (+) present; (–) absent.

Falcomurus **gen. n.** is similar to *Heteromurus* by the presence of 8+8 eyes, Abd. I without macrochaetae and absence of dental spines. *Falcomurus* **gen. n.** can be separated from *Heteromurus* by presence of annulated Ant. III, 9+9 mac on Th. III, 4+4 mac on Abd. II, 3+3 mac on Abd. III and 5+5 mac on Abd. IV, unguis with single paired basal inner teeth and dental base with 1+1 falcate type macrochaetae.

Falcomurus **gen. n.** is also similar to *Verhoeffiella* in having Ant. III-IV annulated and absence of dental spines. However, *Falcomurus* **gen. n.** can be distinguished from *Verhoeffiella* by the presence of 8+8 eyes, dental base with 1+1 falcate type macrochaetae and absence of mucronal basal spine. The detailed difference of *Heteromurus* -like genera having Ant. with 5 segments is given in Table 1.

Description of a new species:

Falcomurus chilikaensis **sp. n.** Mandal
(Figures 1-17)

[urn:lsid:zoobank.org:act:F47C3CA2-EE16-4575-A4BB-FB6237C141CE](https://zoobank.org/act:F47C3CA2-EE16-4575-A4BB-FB6237C141CE)

Type material:

Holotype: female on slide, India: Odisha: Chilika lake near Sabbulia Village, Rambha Town, Ganjam district, Latitude 19°32'00.2" North and Longitude 85°06'04.44" East, Altitude 11 meters, Salinity-17, date 13.ii.2017, Coll. K. Valarmathi, Registration No.2156/H14/ZSI deposited in the National Zoological Collection, Zoological Survey of India, (Kolkata).

Paratype: 1 female on slide, same data as Holotype (Registration No.2157/ H14/ZSI); Paratype: 1 female on slide, same data as Holotype (Registration No.2158 / H14/ZSI); Paratype: 1 female on slide (dissected), same data as Holotype (Registration No.2159/ H14/ZSI) and 15 specimens in ethyl alcohol, same data as Holotype (Registration No.2160 / H14/ZSI) deposited in the National Zoological Collection, Zoological Survey of India, (Kolkata).

Measurement: Body length up to 1.40 mm (excluding appendage). Habitus typical of Heteromurinae (Fig. 1)

Colour pattern: Background colour brownish – white due to body clothed with heavily striated scales. Ant. Ia and Ib, II, III, IV with dark-blue pigment. Eyes dark, a dark spot present between two eyes. All tibio-tarsi dark blue pigmented, light blue pigment present on Abd. VI. No other pigment present on the body.

Head: Eyes 8+8, G & H smaller than the rest (Fig. 3). PAO absent. Antennae 5 segmented and scaled (Fig.4). Antennal segment ratio as Ia : Ib : II: III: IV= 1: 3: 6: 5.5: 9.8 :11.6. Ant. I subdivided (Ia and Ib). Ant II not subdivided and annulated. Ant. III annulated, large number of ciliated setae and smooth setae present. Ant. IV annulated with ciliated setae, smooth setae and 2 apical bulbs. (Fig. 5). Head with large macrochaetae and heavily striated scales. Smooth setae also present on head. Sutural series 'S' with 6+6 macrochaetae, S0 absent. Postsutural & postoccipital shown as head dorsal chaetotaxy in Fig. 6. PLQ with smooth chaetae. Prelabral chaetae smooth, chaetotaxy, labial papillae and proximal chaetae shown as in Fig. 8. Differentiated seta of outer labial papilla as in Fig.9. Prelabral/labral formula 4/5, 5, 4, all smooth chaetae.

Thorax and legs: Ratio of segments of thorax II: III = 1: 1.2. Large numbers of mesothoracic collar macrochaetae. Dorsal chaetotaxy of Th. II to Th. III as in Fig. 7. Th. II chaetotaxy with 11+11 to 15+15 macrochaetae. Th. III with 9+9 macrochaetae. Thorax with heavily striated oval and truncate scales. All legs are scaled. Tibiotarsi with ciliated setae, smooth setae and few macrochaetae (Fig. 12). Unguis with single paired inner basal teeth. Unguiculus broad, lanceolate, without tooth (Fig.14). Tenent hair present on all legs, clavate type. Ventral tube anterior face with smooth setae, lateral faces with 18 long smooth setae (Fig. 10) and posterior face with 3 large macrochaetae (Fig. 11). Trochanteral organ with 16-18 spines like setae (Fig. 13).

Abdomen: Ratio of segments of Abdomen I: II: III: IV: V: VI= 1: 1.4: 2.4: 3.6: 1.2: 0.5. Dorsal chaetotaxy of Abd. I to Abd. IV as in Fig. 7. Abd. I without macrochaetae. Abd. II with 4+4 macrochaetae and 3+3 bothritichia, Abd. III with 3+3 macrochaetae and 3+3 bothritichia, Abd. IV with 5+5 macrochaetae and 2+2 bothritichia, Abd. V with 3+3 macrochaetae, 3 sensilla. Manubrium: dens: mucro = 1: 1.4 : 0.03. Dorsal face of manubrium with multiple rows of unilateral ciliated setae and few small smooth setae (Fig. 15). Ventral face of manubrium with scales only, no setae. Dens dorsally crenulate with unilateral setae, without scale; ventrally with large number of striated scales and setae. Base of dens with 1+1 falcate type macrochaetae (Figs. 16 and 16a). Detal spine absent. Percentage of uncrenulated dens is 11. Mucro bidentate without basal spine (Fig. 17). **Body chaetotaxy:** Body clothed with mostly ciliated setae throughout head, thorax and

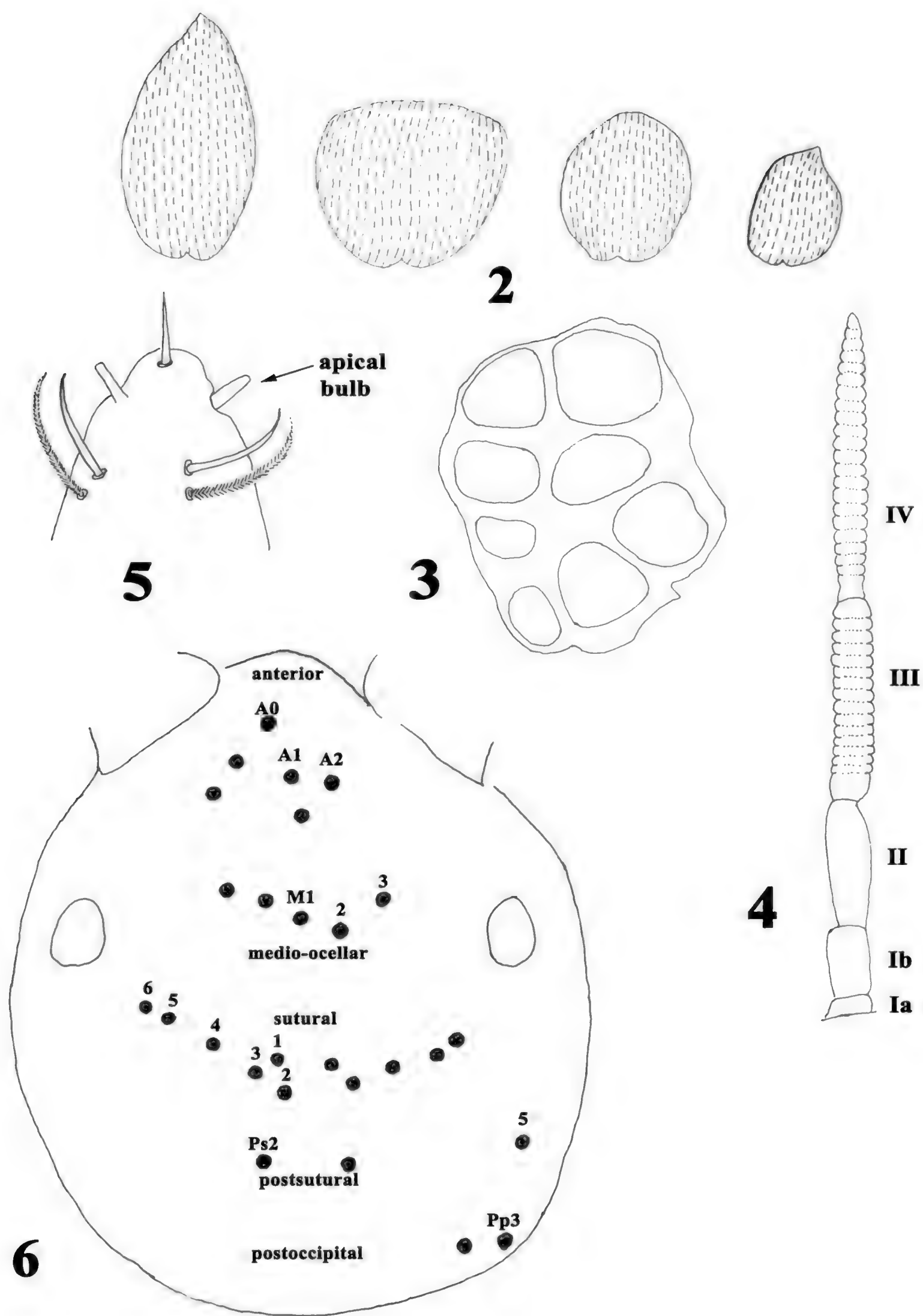
abdomen. Cephalic portion clothed with large macrochaetae. Antennae clothed with scales and different types of ciliated setae and few smooth setae. Scales present on head, thorax, antennae, abdomen, legs and furcula. Scales are heavily striated and different type of shapes- elongate, oval and truncate (Fig. 2).

Remarks

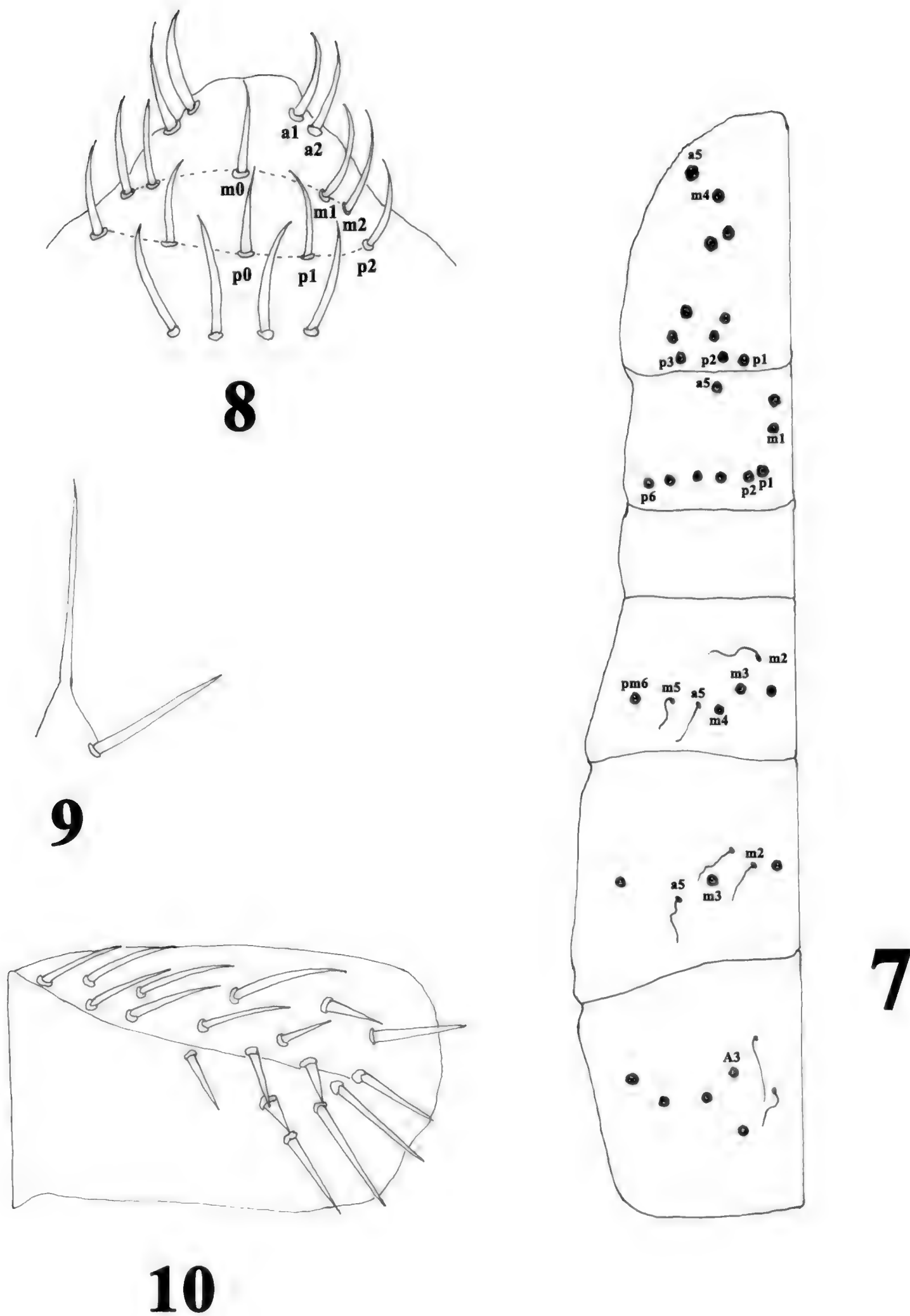
The new species *Falcomurus chilikaensis* **sp. n.** possesses several unique characters compared to its closed taxon, *Heteromurus gigans* Mari Mutt & Stomp, 1980. The new species has Ant. III annulated, unguis with single paired basal inner teeth, dental base with 1+1 falcate type macrochaetae (absent in *H. gigans*). Apex of Ant. IV with two apical blunt setae (absent in *H. gigans*), labial triangle without scales (present in *H. gigans*), mucro without basal spine (present in *H. gigans*).



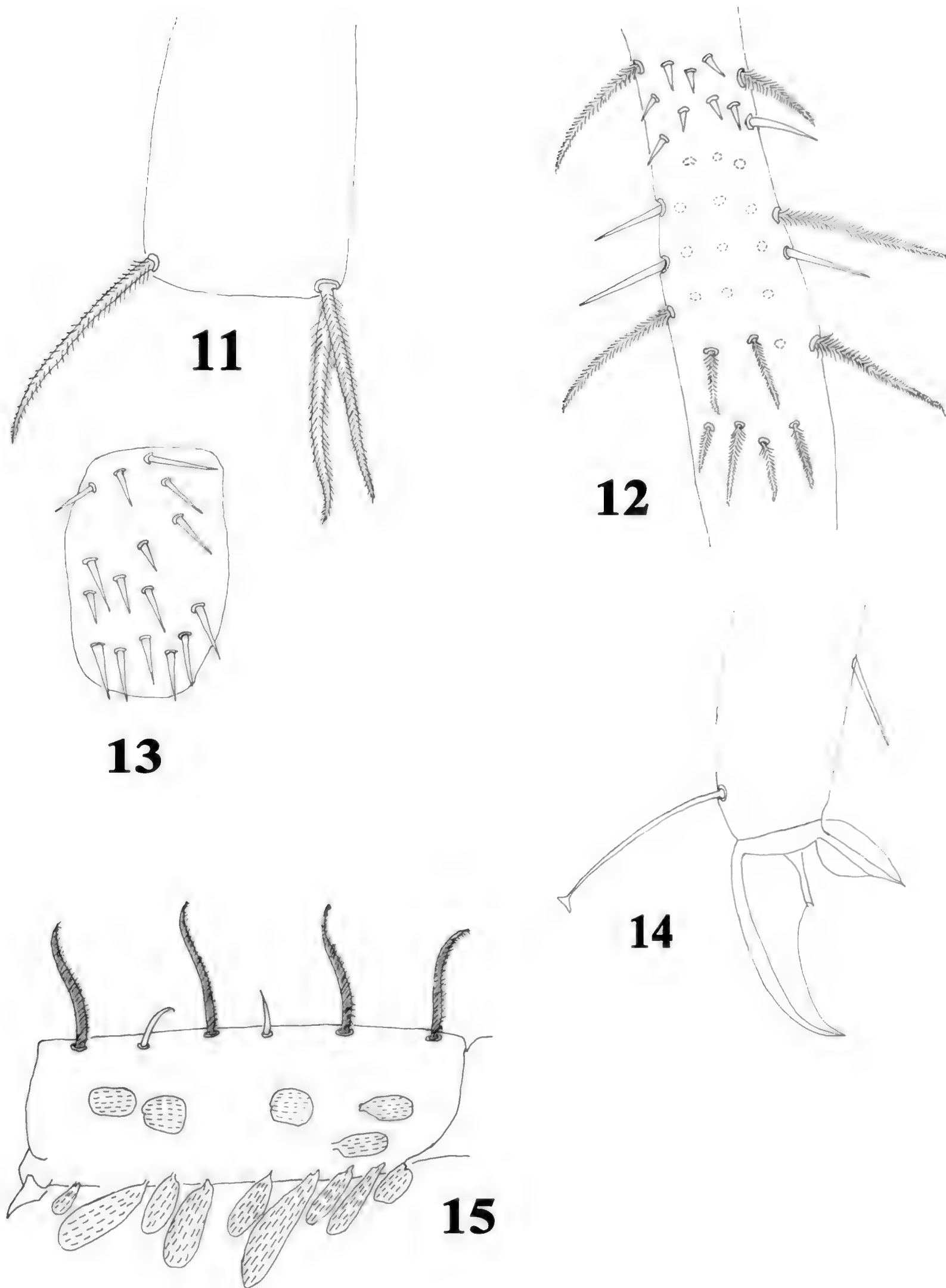
Fig. 1. *Falcomurus chilikaensis* **gen. n. sp. n.**, habitus (lateral view)



FIGURES 2-6. *Falcomurus chilikaensis* gen. n. sp. n.: 2, different shapes of scales; 3, arrangement of eyes; 4, antennae; 5, Ant. V apex; 6, head dorsal chaetotaxy.



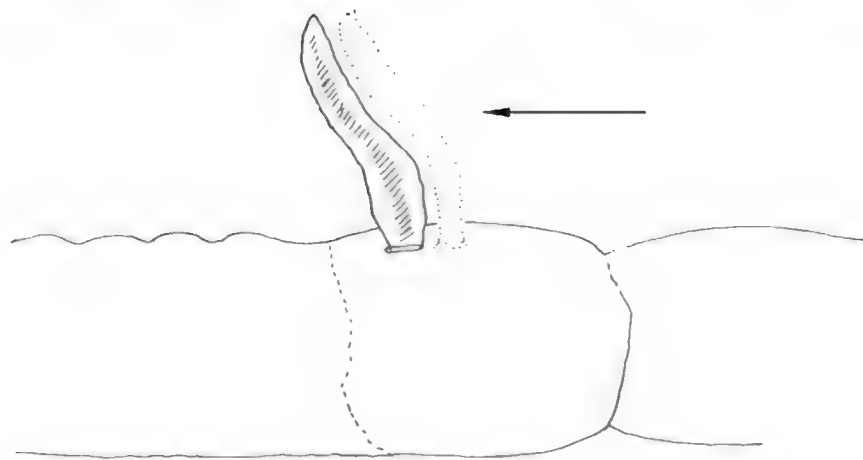
FIGURES 7-10. *Falcomurus chilikaensis* gen. n. sp. n.: **7**, dorsal chaetotaxy of Th. II to Abd. IV; **8**, prelabral and labral chaetotaxy; **9**, outer labial papilla; **10**, Ventral tube (lateral face).



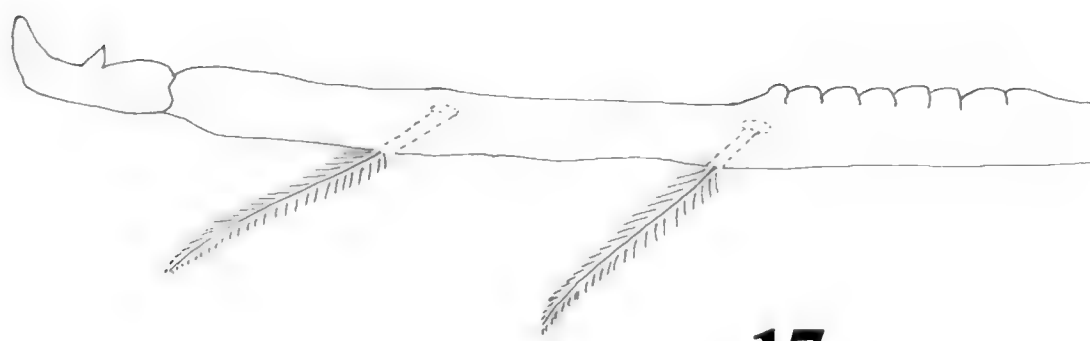
FIGURES 11–15. *Falcomurus chilikaensis* gen. n. sp. n.: **11**, Ventral tube (posterior face); **12**, tibio-tarsi with setae; **13**, Trochanteral organ; **14**, empodial complex (unguis & unguiculus and tenent hair); **15**, manubrium with setae and scales.



16



16a



17

FIGURES 16–17. *Falcomurus chilikaensis* gen. n. sp. n.: 16 and 16a, dens base with falcate macrochaetae; 17, distal dens and mucro.

Etymology

The new species is named after the type locality, Chilika Lake, Odhisa, India.

Distribution

The new species was found in the Chilika Lake near Sabbulia village, Rambha town, Ganjam districts of Odhisa state, India. The area lies between 19°32'00.2" N latitude and 85°06'04.44" E longitude. Altitude of the locality is 11 meters. The climate of the area is tropical.

Habitat

The specimens were found in the intertidal zone of the lake. It is an edaphic species. The specimens were collected from the wet soil under the stones near the intertidal zone of the Chilika Lake.

Discussion

According to Mari Mutt (1980a, b), Heteromurini species are characterized by the presence of dark scales, although species such as *Heteromurtrella anae* (Cipola *et al.*, 2016) and *Alloscopus tetracanthus* (Yosii, 1959) bear hyaline scales. Therefore the coloration of scales should not be taken as a diagnostic character to the Heteromurini. In the other hand the sculpturing of the scales is a characteristic that can possibly be useful to determine the groups of Entomobryidae (Zhang *et al.* 2014). In *Heteromurtrella* the scales can be strongly striated with unaligned rows of stria; or moderately striated with aligned rows of stria (Cipola *et al.*, 2016). This condition is similarly seen in other genera of the tribe and should be investigated due to its potential as a diagnostic feature (Mari Mutt, 1976, 1979a; Zhang *et al.*, 2014).

Although the relationship between Heteromurini genera is uncertain, in this context the dorsal chaetotaxy within the tribe create two distinct groups: *Dicranocentrus* and *Pseudodicranocentrus* with abundant macrochaetae and antennae with 6 segments; and *Heteromurus*, *Alloscopus*, *Heteromurtrella* and *Verhoeffiella* with reduction of macrochaetae and antennae with 5 segments (Mari Mutt, 1977, 1979a, b, 1980b, 1981).

Among this second group, *Heteromurus* and *Verhoeffiella* species are the most similar with each other by reduction on some mac as S0 and Pa2 in the head, Th. III with up to 4 mac, and Abd. I without mac (Mari Mutt, 1985). Both genera are currently distinguished especially by presence of annulations on Ant. III (absent in *Heteromurus*) and *Verhoeffiella* species as cave-dweller organisms (Mari Mutt, 1980a, b), although further characteristics presented in Table 1 can also help to correctly identify the genera.

The absence of head macrochaeta S0 was pointed as an exclusive characteristic of *Heteromurus* (Mari Mutt, 1980b) but it is also absent in some species of *Heteromurtrella*, such as *H. anae* sp. n. and *H. similis*. According to Cipola *et al.* (2016), Abd I macrochaetae distribution is the main characteristic to distinguish *Heteromurus* (absent) to *Heteromurtrella* (present). In the same sense the presence of dorsal spines in dens is not exclusive of *Alloscopus* as it is also present in *Heteromurtrella* as *H. echinata* and *H. tihuiensis*, so the presence of PAO and reduction of head postoccipital macrochaetae (Pa2, Pa3, Pm3 and Pp5) in *Alloscopus* is the main characteristic to distinguish it from other genera (Table 1).

Falcomurus **gen. n.** belongs to the second group with *Heteromurus*, *Alloscopus*, *Heteromurtrella* and *Verhoeffiella*, absence of head macrochaeta S0, reduction of macrochaetae and antennae with 5 segments.

Falcomurus **gen. n.** is similar to *Heteromurus* by the presence of 8+8 eyes, Abd. I without macrochaetae and absence of dental spines. It can be separated from *Heteromurus* by presence of annulated Ant. III, 9+9 mac on Th. III and 5+5 mac on Abd. IV, unguis with single paired basal inner teeth and dental base with 1+1 falcate type macrochaetae.

Falcomurus **gen. n.** is also similar to *Alloscopus* in having Ant. IV annulated, smooth setae on manubrium but it can be distinguished from *Alloscopus* by absence of PAO and dental spines.

Falcomurus **gen. n.** is also similar to *Heteromurtrella* in having PAO absent, Abd. V with 3 sensilla, dens generally without spines

but it can be easily separated from *Heteromurtrella* by presence of 8+8 eyes, annulated Ant. III, unguis with single paired basal inner teeth, dental base with 1+1 falcate type macrochaetae and mucro without basal spine.

Falcomurus **gen. n.** is also similar to *Verhoeffiella* in having Ant. III-IV annulated and absence of dental spines. However, *Falcomurus* **gen. n.** can be distinguished from *Verhoeffiella* by the presence of 8+8 eyes, dental base with 1+1 falcate type macrochaetae and absence of mucronal basal spine.

Acknowledgements

I am grateful to Dr. Kailash Chandra, Director of the Zoological Survey of India, for necessary permission and laboratory facilities. I am thankful to Dr. K. C. Gopi, Scientist-F & in-charge of Entomology Division for support and Dr. K. Valarmathi, Scientist-D, Zoological Survey of India, who collected the specimens. I am also thankful to Dr. A. K. Hazra, ex-Emeritus Scientist, Zoological Survey of India, Kolkata for encouragement. Thanks are also due to all staff members of Apterygota Section namely- Shri K. K. Suman, Senior Zoological Assistant, Shri K. K. Bhattacharya, Senior Zoological Assistant, Shri N. C. Maitra, Junior Zoological Assistant and Shri Souradip Roy for helping in typing the manuscript.

References

- Absolon, K. 1900. Über zwei neue Collembolen aus den Höhlen des österreichischen occupationsgebietes. *Zoologischer Anzeiger* Band 23 (9): 427-431.
- Absolon, K. & Ksenemann, M. 1942. Troglopedetini. Vergleichende Studie über eine altertümliche höhlenbewohnende Collembolengruppe aus den dinarischen Karstgebieten., *Studien aus dem Gebiete der allgemeinen Karstforschung, der wissenschaftlichen Höhlenkunde, der Eiszeitforschung und den Nachbargebieten*, 16: 5-57.
- Bellinger, P.F., Christiansen, K.A. & Janssens, F. (1996-2017). Checklist of the Collembola of the world. Available from: <http://www.collembola.org> (accessed 17 July, 2017)
- Börner, C. 1906. Das System der Collembolen nebst Beschreibung neuer Collembolen des Hamburger Naturhistorischen Museums. *Mitteilungen aus den Naturhistorischen Museum in Hamburg* 23: 147-188.
- Cipola, N.G., Olivera de lima F.G., Morias, De W.J. & Bellini, B.C. 2016. Tribe Heteromurini Absolon & Ksenemann (Collembola, Entomobryidae): a review of the genera status and diagnosis, keys for species of *Alloscopus* Börner and *Heteromurtrella* Mari Mutt and description of a new species. *Zootaxa* 4084(2): 151-186.
- Hopkin, S.P. 1997. *Biology of the Springtails* (Insecta: Collembola). Oxford: Oxford University Press, 330 pp.
- Lučić, L.R., Čurčić, B.P.M. & Tomić, V.T. 2007. *Heteromurus* (*Verhoeffiella*) *constantius*, n. sp. (Collembola, Entomobryidae), from a cave in Herzegovina. *Archives of Biological Sciences, Belgrade* 59 (4): 71-72.
- Lučić, L.R., Tomić, V.T., Brajković, M.M. & Čurčić, S.B. 2008. *Heteromurus* (*Verhoeffiella*) *anagastumensis* n. sp. (Collembola, Entomobryidae), a new cave springtail from Montenegro. *Archives of Biological Sciences, Belgrade* 60 (2): 297-300.
- Mari-Mutt, J.A. 1976. A new species of *Heteromurus* from the Solomon Islands (Collembola: Entomobryidae). *The Pan-Pacific Entomologist* 52: 326-330.
- Mari-Mutt, J.A. 1977. The taxonomic status of *Alloscopus* and redescription of its two species. *The Pan-Pacific Entomologist* 53 (4): 241-249.
- Mari-Mutt, J.A. 1979a. A revision of the genus *Dicranocentrus* Schött (Insecta: Collembola: Entomobryidae). *Agricultural Experiment Station Bulletin* 259, 1-79.
- Mari Mutt, J.A. 1979b. *Heteromurtrella*, a new tropical subgenus of *Heteromurus* with description of two new species (Insecta: Collembola: Entomobryidae). *The Journal of Agriculture of the University of Puerto Rico* 63(2): 214-222.

- Mari-Mutt, J.A. 1980a. A classification of the Orchesellinae with a key to tribes, genera and subgenera (Collembola: Entomobryidae). *Annals of the Entomological Society of America* 73 (4): 455–459.
- Mari-Mutt, J.A. 1980b. A Revision of *Heteromurus* s. str. (Insecta: Collembola: Entomobryidae). *Transactions of the Illinois State Academy of Science* 72 (3): 29–50.
- Mari-Mutt, J.A. 1981. New genus, a new species, and complements to the descriptions of seven Neotropical *Dicranocentrus* (Collembola: Entomobryidae: Orchesellinae). *The Journal of Agriculture of the University of Puerto Rico* 65 (2): 90–107.
- Mari-Mutt, J.A. 1985. Contribución al conocimiento de tres especies de Orchesellinae descritas por F. Bonet y redescipción de *Orchesellides sinensis* (Denis) (Collembola). *Eos* 61: 189–198.
- Mari-Mutt, J.A. & Stomp. N. 1980. Two new species *Heteromurus* S. Str. from Portugal and Romania (Insecta: Collembola, Entomobryidae). *Archives d' Institut Grand-Ducal de Luxembourg, Section des Sciences naturelles, physiques et mathématiques* 38: 183–189.
- Schött, H. 1893. Beitrage zur kenntnis der insektenfauna von Kamerun. *Konglita Svenska Vetenskaps-Akademiens Handlingar* 19: 5–28.
- Soto-Adames, F.N., Barra, J.A., Christiansen, K. & Jordana, R. 2008. Suprageneric Classification of the Entomobryomorph Collembola. *Annals of the Entomological Society of America* 101 (3): 501–513.
- Thibaud, J.-M. & Massoud, Z. 1973. Essai de classification des Insectes Collembolés cavernicoles européens. *Comptes Rendus Academie Sciences* 277: 2137–2140.
- Tömösvary, O. 1882. Adatok hazánk Thysanura-Faunajához. *A Magyar Tudományos Akadémia Matematikai és Természettudományi Közlemények* 18: 1–131.
- Wankel, H. 1860. Beiträge zur fauna der Mäharichen Höhlen. *Lotos, Prague* 10: 201–206.
- Yosii, R. 1959. Studies on the Collembolan Fauna of Malay and Singapore with special reference to the Genera: *Lobella*, *Lepidocyrtus* and *Callyntrura*. *Contributions from the Biological Laboratory Kyoto University* 10: 1–65.
- Zhang, F., Chen, Z., Dong, R.-R., Deharveng, L., Stevens, M.I., Huang, Y.-H. & Zhu, C.-D. 2014. Molecular phylogeny reveals independent origins of body scales in Entomobryidae (Hexapoda: Collembola). *Molecular Phylogenetics and Evolution* 70: 231–239.
- Zhang, F. & Deharveng, L. 2015. Systematic revision of Entomobryidae (Collembola) by integrating molecular and new morphological evidence. *Zoologica Scripta* 44: 298–311.

A taxonomic review of the genus *Vespula* Thomson (Hymenoptera: Vespidae: Vespinae) from the Indian subcontinent

*P. Girish Kumar¹ and James M. Carpenter²

¹Western Ghats Regional Centre, Zoological Survey of India, Kozhikode, Kerala-673006, India.

²Division of Invertebrate Zoology, American Museum of Natural History, Central Park West at 79th Street, New York, NY 10024, USA.

(Email: kpgiris@gmail.com)

Abstract

The genus *Vespula* Thomson, 1869, is reviewed from the Indian subcontinent. New synonymy is *Vespa orbata* var. *aurulenta* du Buysson, 1905, = *Vespula structor* (Smith, 1870). The following species are newly recorded from various states of India as follows: *V. nursei* Archer, 1981, from Delhi, Sikkim and Uttarakhand; *V. orbata* (du Buysson, 1902) from Nagaland; *V. flaviceps* (Smith, 1870) from West Bengal; *V. germanica* (Fabricius, 1793) from Himachal Pradesh; *V. structor* (Smith, 1870) from Arunachal Pradesh; *V. vulgaris* (Linnaeus, 1758) from Himachal Pradesh. Parasitic association of Strepsiptera is observed in one worker specimen of *V. flaviceps*. A modified key to species of the Indian subcontinent is provided.

Keywords: *Vespula*, review, Indian subcontinent, new record, ethology.

Received: 19 December 2017; Revised: 31 May 2018; Online: 1 June 2018.

Introduction

Thomson (1869) erected *Vespula* as a subgenus of *Vespa* based on eight species; the type species *Vespa austriaca* Panzer, 1799, was subsequently designated by Ashmead (1902). Members of this social wasp genus are commonly called yellow jackets. They usually make underground nests. They are widely distributed in the Northern Hemisphere. Currently, 25 species are recorded worldwide of which 10 species are present in the Indian subcontinent. In this paper, we review the Indian subcontinent species. A new synonymy is proposed in this paper, i.e., *Vespa orbata* var. *aurulenta* du Buysson, 1905, is synonymized under *Vespula structor* (Smith, 1870). The distributional records of many species are augmented in this paper. Parasitic association of Strepsiptera is observed in one worker specimen of *V. flaviceps*. A key to species of the Indian subcontinent is also provided.

Materials and Methods

This study is based primarily on the specimens present in the Zoological Survey of

India. Most of the specimens were properly preserved and added to the 'National Zoological Collections' of the Hymenoptera Section of the Zoological Survey of India, Kolkata (NZC) and some of the specimens at Western Ghat Regional Centre of the Zoological Survey of India, Kozhikode (ZSIK).

List of repositories: Beijing — Institute of Zoology, Academia Sinica; Budapest — Hungarian Natural History Museum; Dresden — Staatliches Museum für Tierkunde; Genève — Museum d'Histoire Naturelle; Linnean Society — Linnean Society, London; London — The Natural History Museum; New York — American Museum of Natural History; Paris — Laboratoire d'Entomologie, Museum National d'Histoire Naturelle; Stockholm — Naturhistoriska Riksmuseet (Entomologiska); Taichung — Taiwan Agricultural Research Institute; Washington — U. S. National Museum of Natural History; Wien — Zoologische Sammlung, Naturhistorisches

Museum; Yunnan — Kunming Natural History Museum of Zoology.

Abbreviations used for the terms: HW = Head width; L = Length; OMS = Oculo-malar space; S = Metasomal sterna; T = Metasomal terga; W = Width.

Results and Discussion

Genus *Vespula* Thomson, 1869

Vespula Thomson, 1869: 79, subgenus of *Vespa* (eight species). Type species: *Vespa austriaca* Panzer, 1799, by subsequent designation of Ashmead, 1902: 164.

Pseudovespa Schmiedeknecht, 1881: 314, subgenus of *Vespa* Linnaeus. Type species: *Vespa austriaca* Panzer, 1799, by monotypy.

Paravespula Blüthgen, 1938: 271, subgenus of *Dolichovespula* Rohwer. Type species: *Vespa vulgaris* Linnaeus, 1758, by original designation.

Allovespula Blüthgen, 1943: 149, subgenus of *Paravespula* Blüthgen. Type species: “*Paravespula rufa* (Linné)” [= *Vespa rufa* Linnaeus, 1758], by monotypy.

Rugovespula Archer, 1982: 261, 264, subgenus of *Vespula* Thomson. Type species: *Vespa koreensis* Radoszkowski, 1887, original designation.

Diagnosis: Oculo-malar space short, as short as or shorter than apical diameter of scape; pronotal carina absent or faintly marked ventrally; female with outer flange on mandible; eye almost touching base of mandible; occipital carina present laterally, reaching or not reaching base of mandible, sometimes weak; male antenna with long scape, equal to or little shorter than third flagellar segment, later without tyloids; branches of aedeagus fused resulting in disc-like or saddle-shaped apical lobe; aedeagus longer than parameres.

Distribution: Eurasia, North Africa, North America, Central America. Adventive in Australia, New Zealand, Tahiti, Hawaii, South Africa, Chile, Argentina.

Key to species of the genus *Vespula* Thomson from the Indian subcontinent (Modified from Archer, 2012)

1. T1 usually with long black hairs; occipital carina not extending to base of mandible;

lateral mesoscutal depression without a backwardly directed depression; posterolateral margin of S6 of female evenly convex; profile of T7 convex in male; shape of S7 almost triangular in male; male genitalia with digitus small, not extending to level of parameral spine; apex of aedeagus strap-shaped and cuspis cone-shaped, without dorsal lobe.....

rufa species group. 2

— T1 usually with long pale hairs; occipital carina usually extending to base of mandible; lateral mesoscutal depression with a backwardly directed depression (sometimes indistinct on workers); posterolateral margin of S6 of female with a backwardly directed projection; profile of T7 concave in male; shape of S7 transversely rectangular in male; male genitalia with digitus large, extending nearly as far as or beyond the level of parameral spine; apex of aedeagus not strap-shaped but either boat-shaped or spoon-shaped and cuspis pyramid-shaped with a dorsal lobe. 7

2. Hind tibia with long erect hairs; apex of clypeus sharply produced in females, bluntly produced in males. [Worker caste absent].....*austriaca* (Panzer)

— Hind tibia without long erect hairs; apex of clypeus bluntly produced in females, hardly produced at all in males. [Worker caste present]..... 3

3. Large punctures on mesoscutum with distance between punctures usually more or less equal or less than the diameter of punctures except at middle where punctures are further apart; large punctures of two sizes with normally a single smaller puncture between larger punctures; micropunctures shallow so that surface between them appears polished.....

.....*rufa* (Linnaeus)

— Large punctures on mesoscutum with distance between punctures usually greater than the diameter of punctures; large punctures of two sizes with normally two smaller punctures between larger punctures; micropunctures deep so that surface between them appears dull..... 4

4. Females (queens and workers)..... 5

— Males..... 6

5. Oculo-malar space short, about 1/20 to 1/25 the width of head; occipital carina long, occupying about 70% of the lateral length

- of head; clypeus largely yellow with either each lateral yellow stripe broader than median black stripe or yellow with three black spots; metanotum with two yellow spots. ***nursei* Archer**
- Oculo-malar space longer, about 1/14 to 1/17 the width of head; occipital carina short, occupying about 50% of the lateral length of head; clypeus largely black, with each lateral yellow stripe narrower than median black stripe; metanotum without yellow spots. ***kingdonwardi* Archer**
6. Clypeus more than 50% yellow, black median stripe narrow and/or incomplete; metanotum with two yellow spots; coxa with yellow spot. ***nursei* Archer**
- Clypeus less than 50% yellow, black median stripe broad and complete; metanotum without yellow spots; coxa without yellow spot. ***kingdonwardi* Archer**
7. T1 raised basally with a depression behind this elevation (sometimes indistinct in workers); In female, outer basal flange of mandible nearly straight; In queen, propodeum coarsely rugose all or over major part of its surface; backwardly directed postero-lateral projection on S6 sharply pointed; In worker, either propodeum rugose or if not clearly rugose in dorsal aspect, then body tricoloured (black, yellow, brown); lower side of second submarginal cell on the medial vein before the point of contact with second medio-cubital or recurrent vein shorter than the lower side of second submarginal cell after the point of contact with the recurrent vein; In male, shaft of aedeagus broad and its apex boat-shaped; dorsal terminal process of gonostipes weakly developed; T7 deeply notched. ***koreensis* species group** 8
- T1 not raised basally and without a depression; In female, outer basal flange of mandible strongly curved (sometimes indistinct in workers); In queen, propodeum not coarsely rugose, surface smooth with punctures and only weakly rugose around petiole junction; backwardly directed postero-lateral projection on S6 bluntly rounded; In worker, propodeum not rugose and in dorsal aspect body bicoloured (black, yellow) except for *V. structor* and some *V. flaviceps* which are tricoloured (black, yellow, brown); lower side of second submarginal cell on the medial vein before the point of contact with the second medio-cubital or recurrent vein as long as or longer than the lower side of second submarginal cell after the point of contact with the recurrent vein; In male, shaft of aedeagus narrow and its apex spoon-shaped; dorsal process of gonostipes well developed and projects laterally; T7 either slightly or not at all notched. ***vulgaris* species group**. 13
8. Female (queens and workers). 9
- Males. 12
9. Queens (usually body length greater than 15.5 mm and forewing length greater than 13 mm). 10
- Workers (usually body length less than 15.5 mm and forewing length less than 13 mm). 11
10. Propodeum very coarsely rugose all over its surface and without punctures; ventral metapleura anteriorly and ventro-laterally strongly rugose. ***koreensis* (Radoszkowski)**
- Propodeum less coarsely rugose and punctures between and interrupting the rugae; ventral metapleura without strong rugae. ***orbata* (du Buysson)**
11. Mesoscutal punctures dense with distances between punctures equal to diameter of punctures; propodeum rugose and with punctures between and interrupting the rugae; if the rugae indistinct then the body in dorsal aspect clearly bicoloured (black, yellow. ***koreensis* (Radoszkowski)**
- Mesoscutal punctures usually less dense with distances between punctures greater than diameter of punctures; propodeum not rugose, only punctate; body in dorsal aspect tricoloured (black, yellow, brown); brown particularly visible on vertex, pronotum and mesoscutum although sometimes restricted in amount. ***orbata* (du Buysson)**
12. Propodeum rugose, without punctures; dorsal terminal process almost absent, indicated by a slight undulation on margin of gonostipes. ***koreensis* (Radoszkowski)**
- Propodeum punctate, without rugae; dorsal terminal process weakly developed but with a distinct projection on margin of gonostipes. ***orbata* (du Buysson)**
13. Female (queens and workers). 14

- Males.....21
- 14. Queens (usually body length greater than 13 mm and forewing length greater than 11 mm).15
- Workers (usually body length less than 13 mm and forewing length less than 11 mm).18
- 15. Occipital carina not extending to base of mandible, usually extends for less than $\frac{3}{4}$ of lateral length of head; light coloured ocular sinus not deeply penetrated by a medial black projection; black mark on clypeus, if present, usually not reaching apical margin.....*flaviceps* (Smith)
- Occipital carina extending to base of mandible; other characters partly or completely different. 16
- 16. Margin behind third mandibular tooth distinctly concave.....*germanica* (Fabricius)
- Margin behind third mandibular tooth straight or at most slightly concave. 17
- 17. Bi-coloured (yellow and black); scutellum and metanotum black, with yellow spots; clypeus yellow with black median mark; oculo-malar space shorter, HW/OMS greater than 19.....*vulgaris* (Linnaeus)
- Tri-coloured (yellow, black and brown); brown colour particularly visible on pronotum, T2 and S2-S4; scutellum and metanotum black, without yellow spots, at most with brown markings; clypeus yellow to orange without a black median mark; oculo-malar space longer, HW/OMS less than 18....*structor* (Smith)
- 18. Light colour of gastral terga orange yellow; dorsal surface of T1 without or almost without black marking; metanotum without a yellow mark....*structor* (Smith)
- Light colour of gastral terga yellow; dorsal surface of T1 with a distinct black marking; metanotum with a yellow mark..... 19
- 19. Margin behind third mandibular tooth distinctly concave; lateral surface of mesosoma (mesepisternum, mesepimeron, dorsal and ventral metapleura) with at least some long black hairs; if (rarely) no black hairs present, then long hairs white.*germanica* (Fabricius)
- Margin behind third mandibular tooth straight or at most slightly concave; other characters partly or completely different.20
- 20. Occipital carina incomplete only extending just over half way from vertex to mandible; yellow area of ocular sinus with a slightly convex medial margin and slightly separated from yellow shield of frons.....*flaviceps* (Smith)
- Occipital carina complete, extending from vertex to mandible, but disappearing for a short distance near mandible and then reappearing and reaching to mandible; yellow area of ocular sinus with a concave medial margin and widely separated from yellow shield of frons.....*vulgaris* (Linnaeus)
- 21. Aedeagus without a small backwardly directed pointed barb on each side below the apical spoon-shaped region; aedeagus emarginated apically; aedeagus with a small semicircular projection on each side below apical spoon-shaped region; dorsal terminal process of gonostipes equal to, or less than width of shaft of aedeagus.*germanica* (Fabricius)
- Aedeagus with a small backwardly directed pointed barb on each side below the apical spoon-shaped region; aedeagus rounded apically; other characters partly or completely different. 22
- 22. Volsella visible in ventral view of gonostipes; light coloured area of ocular sinus not deeply penetrated by a medial black projection, medial margin straight or convex or continuous with the light coloured area of frons; mandible without a triangular black spot at its base; genitalia short, L/W less than one.....*flaviceps* (Smith)
- Volsella not visible in ventral view of gonostipes; other characters partly or completely different.23
- 23. Gastral terga not covered by short brown hairs so that the light coloured areas appear clear yellow; metanotum with yellow spots; light coloured areas of frons and ocular sinus parallel, or diverging dorsally, so that they are clearly separated.*vulgaris* (Linnaeus)
- Gastral terga covered by short brown hairs so that the light coloured areas appear orange-brown; metanotum without yellow spots; light coloured areas of frons and ocular sinus either continuous or only narrowly separated.....*structor* (Smith)

The *rufa* species group

Four species of *rufa* species group, namely, *Vespula austriaca* (Panzer, 1799), *V. rufa* (Linnaeus, 1758), *V. nursei* Archer, 1981 and *V. kingdonwardi* Archer, 1981, are present in the Indian subcontinent.

1. *Vespula austriaca* (Panzer, 1799)

Vespa austriaca Panzer, 1799: 2, fig. 2, male, “Viennae Austr.” (destroyed).

Vespa borealis Smith, 1843: 170, fig., female, “Yorkshire... the north of Scotland” (London). Junior primary homonym of *Vespa borealis* Kirby, 1837, and of *Vespa borealis* Zetterstedt, 1840.

Vespa arborea Smith, 1849: 1x. Replacement name for *Vespa borealis* Smith.

Vespa biloba Schilling, 1850: 77, [Poland] “Schlesien” (type depository unknown).

Vespa arborea “Ross” Dalla Torre, 1894: 138, as a synonym of *Vespa austriaca* Panzer. Junior primary homonym of *Vespa arborea* Smith, 1849.

Diagnosis: *Female:* Apex of clypeus sharply produced; occipital carina present only laterally; mesoscutum and scutellum dull with sparse shallow punctures; metanotum dull with fine shallow punctures; metasoma dull; body covered with long black erect hairs; hind tibia with characteristic long erect hairs; clypeus usually with 2-3 black spots; scape yellow ventrally; ocular sinus yellow at ventral side; metasoma without reddish areas.

Male: Apex of clypeus bluntly produced; genitalia with basal part of aedeagus narrower than the apical part, the apex evenly rounded and without lateral projections, but with subapical constriction; volsella short, extending only up to the base of the apical part; aedeagus entirely light brown.

Length: Female, 15-18 mm; male, 13-16 mm.

Ethology: It is an obligatory parasite that does not construct its own nest and breeds in the nests of other *Vespula* species such as *V. nursei*, *V. acadica* and *V. rufa* (Williams, 1988; Archer, 2007). It does not produce a worker caste.

Material examined: No specimens from the Indian subcontinent were available for our studies. We compared the species description from Das and Gupta (1989) with a queen from Suisse - Valais/Grimentz/13 VII - 2 VIII 1941/J. de Beaumont, and a male from Germany and Coll. Konow without further

data (New York).

Distribution: India: Jammu & Kashmir; Pakistan. Elsewhere: Albania; Austria; Belarus; Belgium; Bosnia & Herzegovina; Bulgaria; Canada; China; Croatia; Czech Republic; Denmark; Estonia; Finland; France; Georgia; Germany; Greece; Hungary; Ireland; Italy; Japan; Kazakhstan; Korea; Kyrgyzstan; Latvia; Liechtenstein; Lithuania; Luxembourg; Macedonia; Moldova; Mongolia; Netherlands; Norway; Poland; Romania; Russia; Serbia; Slovakia; Slovenia; Spain; Sweden; Switzerland; Turkey; U. K.; Ukraine.

2. *Vespula rufa* (Linnaeus, 1758)

Vespa rufa Linnaeus, 1758: 572, “in Europa” (lectotype female, Linnean Society). Additional citation: Day, 1979: 71 (designation of lectotype).

Vespa schrenckii Radoszkowski, 1861: 84, figs. 4-5, [Russia] “Amur” (type depository unknown).

Vespa sibirica André, 1884: 599, female, male, [Russia] “Sibérie” (Paris?).

Vespa schrenki; Dalla Torre, 1904: 66. Incorrect spelling of *Vespa schrenckii* Radoszkowski.

Vespa rufa grahami Archer, 1981: 54, 62, female, male – “CHINA, Szechuen, 30 miles north of Tatsienku” (Washington); also from elsewhere in Sichuan.

Vespula obscura Lee, 1986: 201, 205, 206, fig. 5, female – [China] “Zogang County, Xizang (Tibet) Aut. Reg., 3800 m” (Beijing); also from another locality in Xizang.

?*Vespula yichunensis* Lee, 1986: 202, 203, 206, fig. 3, female – [China] “Yichun City, Heilongjiang Province” (Beijing).

Vespula yulongensis Dong and Wang, 2002, in Dong *et al.*: 396, figs. 1- 5, female - “Yunnan China” (Yunnan).

Vespula shinanoensis: Takamizawa, 2005, The Japanese Social Wasps and Bees: 147, 148 (in subgenus *Vespula*). Nomen nudum, described without mentioning repository of the holotype (Articles 13 and 16.4 of the International Code of Zoological Nomenclature).

Diagnosis: *Female:* Large punctures on mesoscutum with distance between punctures

usually more or less equal or less than the diameter of punctures except at middle where punctures further apart; large punctures of two sizes with normally a single smaller puncture between larger punctures; micropunctures shallow so that the surface between them appears polished; metanotum and metasoma more shiny with finer micro sculpture and more superficial punctation; tibiae with sparse hairs; a dagger-shaped mark on clypeus; T1 and T2 partly red.

Male: Aedeagus not constricted basally, its basal part with thick walls; T1 and T2 with red spots.

Material examined: No specimens from the Indian subcontinent were available for our studies. We compared the species description from Das and Gupta (1989) with a queen from Europe without further data, two workers from Bressoux/Belgium/22/7/52 and Tolumierz/22/X/1990/E. Yildirim, and two males from Tolumierz/22/X/1990/E. Yildirim and Maele W/Brugge/Belgium (New York).

Distribution: Nepal. Elsewhere: Afghanistan; Albania; Austria; Azerbaijan; Belarus; Belgium; Bosnia & Herzegovina; Bulgaria; China; Croatia; Czech Republic; Denmark; Estonia; Finland; France; Georgia; Germany; Greece; Hungary; Iceland; Ireland; Italy; Japan; Kazakhstan; Kyrgyzstan; Korea; Latvia; Liechtenstein; Lithuania; Luxembourg; Macedonia; Moldova; Mongolia; Netherlands; Norway; Poland; Romania; Russia; Serbia; Slovenia; Slovakia; Spain; Sweden; Switzerland; Taiwan; Tajikistan; Turkey; U.K.; Ukraine; Uzbekistan.

3. *Vespula nursei* Archer, 1981

(Figs. 1-12)

Vespula nursei Archer, 1981: 54, 57, fig. 4A-B, female, male. "INDIA, Kashmir, 8-9,000 ft" (holotype female London); also from other localities in Kashmir, Punjab, Himachal Pradesh; China; Philippines.

Diagnosis: *Female:* Oculo-malar space short, about 1/20 to 1/25 the width of head; clypeus with coarse punctures separated by more than their diameters; lateral angles of clypeus triangular and projecting outwards; occipital carina long, occupying about 70% of lateral length of head; pronotal carina absent; pronotum punctate and weakly striate

ventrally; large punctures on mesoscutum with distance between punctures usually greater than the diameter of punctures; large punctures of two sizes with normally two smaller punctures between larger punctures; micropunctures deep so that surface between them appears dull; propodeum punctate, weakly striate ventro-laterally; apical margin of S6 evenly convex.

Colour: Head black with yellow marks as follows: most of clypeus except linear black mark medially; frons with a shield reaching antennal bases; stripe along ocular sinus extending to clypeus; mandible; small spot posteriorly and large linear mark anteriorly on gena. Mesosoma black with yellow marks as follows: stripe on pronotum parallel sided; tegula; spot just below hind wing; two spots on scutellum; metanotum with two spots anteriorly; triangular spot on mesepisternum. Legs with coxae black or dark brown with small yellow spot; femur mainly light brown; tibia and tarsus brown with yellow dorsal marks. Metasoma with black, reddish brown and pale yellow marks as in figure 6. Body hairs long and black; legs with long black hairs on coxa, trochanter and femur.

Male: Clypeal angles absent, apical margin of clypeus almost straight; antennal tyloids absent; apical margin of S6 deeply concave; S7 almost triangular. Colouration similar to that of female except as follows: clypeus almost completely yellow except narrow black median stripe; gena with anterior yellow stripe along its entire length.

Length (H+M+T1+T2): Queen, 12.5-13.5 mm; Worker, 9.5-10.5 mm; Male, 9.5-11.5 mm.

Material examined: INDIA: Delhi, Delhi University Ridge, 1 worker, date of collection and name of collector unknown, NZC Regd. No. 17587/H3; Delhi University Campus, 1 male, 27.x.1978, Coll. Meenakshi, NZC Regd. No. 17588/H3. Himachal Pradesh, Shimla district, Chini Bungalow, 1 worker, 11.x.1962, Coll. V.K. Gupta, NZC Regd. No. 17589/H3; Shimla district, Narkanda, 2 worker & 1 male, 5.x.1966-13.x.1971, Coll. V.K. Gupta & Party, NZC Regd. Nos. 17591/H3-17593/H3; Shimla, 1 male, 3.x.1966, Coll. Ram, NZC Regd. No. 17590/H3; Chamba district, Khajjiar, 1 worker, 27.vi.1965, Coll. Tikar, NZC Regd. No. 17600/H3; Chamba district, Dainkund, 1 worker, 11.vi.1971, Coll. Unknown, NZC Regd. No. 17594/H3. Jammu

& Kashmir, Baramulla district, Gulmarg, 1 worker, 17.vi.1966, Coll. Joseph, NZC Regd. No. 17595/H3; Baramulla district, Chandanwari, 1 male, 1.x.1978, Coll. Rina, NZC Regd. No. 17597/H3; Srinagar, 1 male, 6.ix.1978, Coll. A. Kaur, NZC Regd. No. 17596/H3; Anantanag district, Pahalgam, 1 male, 2.x.1978, Coll. Bindu, NZC Regd. No. 17598/H3. Sikkim, East Sikkim district, Gangtok, 1 worker, 13.v.1966, Coll. Tikar, NZC Regd. No. 17599/H3. Uttarakhand, Uttarkashi district, Harsil, 5 worker, 9–13.vi.1977, Coll. V.K. Gupta & Party, NZC Regd. Nos. 17601/H3–17605/H3.

Distribution: India: Delhi (new record), Himachal Pradesh, Jammu & Kashmir, Punjab, Sikkim (new record), Uttarakhand (new record); Pakistan. Elsewhere: China; Philippines.

4. *Vespula kingdonwardi* Archer, 1981

Vespula kingdonwardi Archer, 1981: 54, 57 (key), 60, fig. 4C-D, female, male – [China] “TIBET, Kashmir, 28.25 N 97.55 E” (holotype female London); also from other localities in Xizang; Myanmar.

Vespula hirsuta Lee, 1986: 201, 204, 206, fig. 4, female – [China] “Markham County, Xizang (Tibet) Aut. Reg., 3300 m” (Beijing).

Diagnosis: Female: Oculo-malar space longer, about 1/14 to 1/17 the width of head; occipital carina shorter, occupying about 50% of the lateral length of head; large punctures on mesoscutum with distance between punctures usually greater than the diameter of punctures; large punctures of two sizes with normally two smaller punctures between larger punctures; micropunctures deep so that surface between them appears dull.

Colour: Head black with yellow marks as follows: clypeus largely black with lateral narrow yellow stripes; frons with a shield reaching antennal bases; a stripe along ocular sinus not extending to clypeus; Mesosoma black with yellow marks as follows: a stripe on pronotum parallel sided; tegula brown with spots. Metasoma black with reddish brown and yellow markings; vertical face of T1 reddish brown with dorsal and ventral black marks. Body hairs long and black; legs with long black hairs on coxa, trochanter and femur.

Male: Clypeal angles absent, apical margin of clypeus truncate; antennal tyloids absent;

apical margin of T7 not notched, convex in profile; apical margin of S6 concave; S7 almost triangular; genitalia like that of *V. rufa* and *V. nursei*. Colouration similar to that of female except gena with anterior yellow stripe along its entire length.

Length: Queen, 17 mm; Worker, 12–13.2 mm; Male, 13–14.7 mm.

Distribution: Myanmar; Nepal. Elsewhere: China.

Remarks: Specimens of this species was not available for our studies; hence the species diagnosis, colour description and length are taken from Das & Gupta (1989).

The *koreensis* species group

This species group consists of only three species, namely, *Vespula koreensis* (Radoszkowski, 1887), *V. orbata* (du Buysson, 1902) and *V. arisana* (Sonan, 1929) of which the first two species are present in the Indian subcontinent.

5. *Vespula koreensis* (Radoszkowski, 1887)

Vespa koreensis Radoszkowski, 1887: 432, male, female. “Korée” (lectotype female London). Additional citation: Archer, 1982: 263, 267 (designation of lectotype).

Vespa germanica var. *stizoides* du Buysson, 1905: 494 (key), 615, female. “Nord de l’Inde” (holotype London).

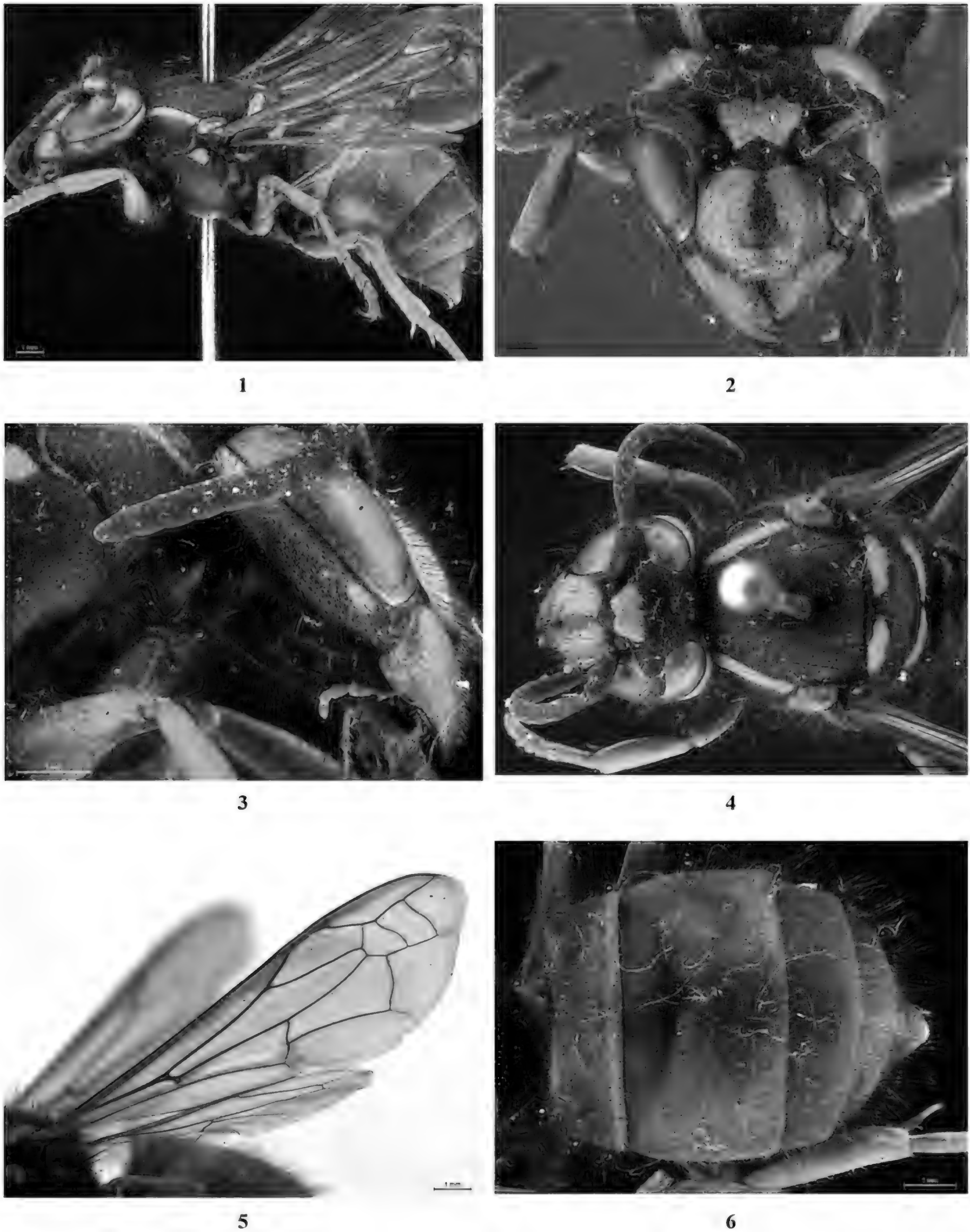
Pseudovespa birulai Gussakovskii, 1932: 52, female. [Russia] “Ussuri-Geb.: Tigrovaja...; Sutshan...Sedanka...Kreis Chabarowsk...Wladiwostok” (Stockholm).

Vespula koreensis salebrosa Archer, 1982: 261, 267, female. “CHINA: Szechuen, Suifu” (London); also from other localities in China.

Vespula hainanensis Lee, 1986: 201, 202, 206, fig. 1, female. [China] “Hainan Island, Guangdong Province” (Beijing).

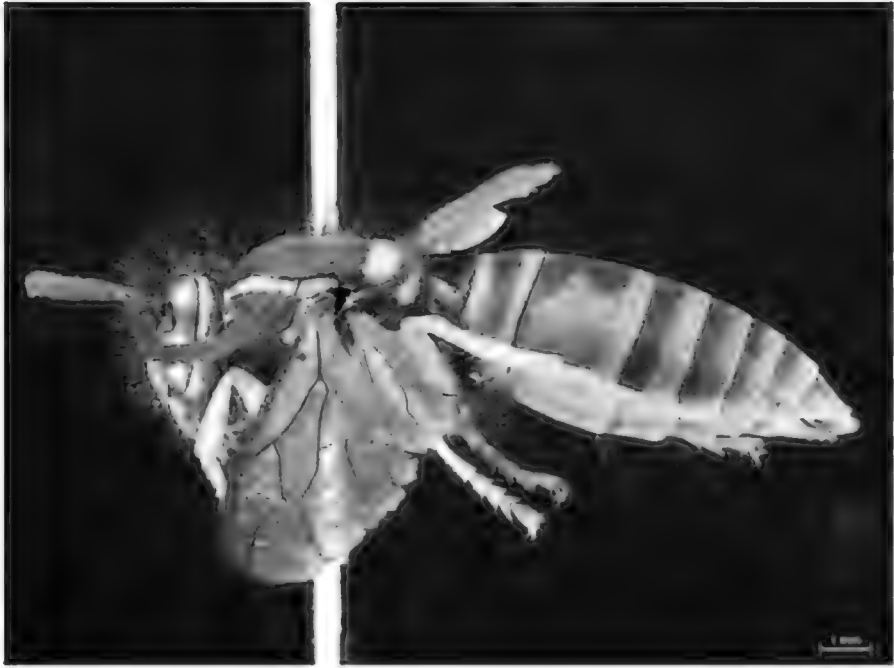
Diagnosis: T1 raised basally with a depression behind this elevation (sometimes indistinct in workers). *Female* (queens and workers): outer basal flange of mandible nearly straight. In queen, propodeum very coarsely rugose all over its surface and without punctures; ventral metapleuron anteriorly and ventro-laterally strongly rugose; backwardly directed postero-

Plate 1



Figs 1-6: *Vespula nursei* Archer, worker. 1: Body, in profile. 2: Head, in frontal view. 3: Head, in lateral view. 4: Head and mesosoma, in dorsal view. 5: Wings. 6: Metasoma, dorsal view.

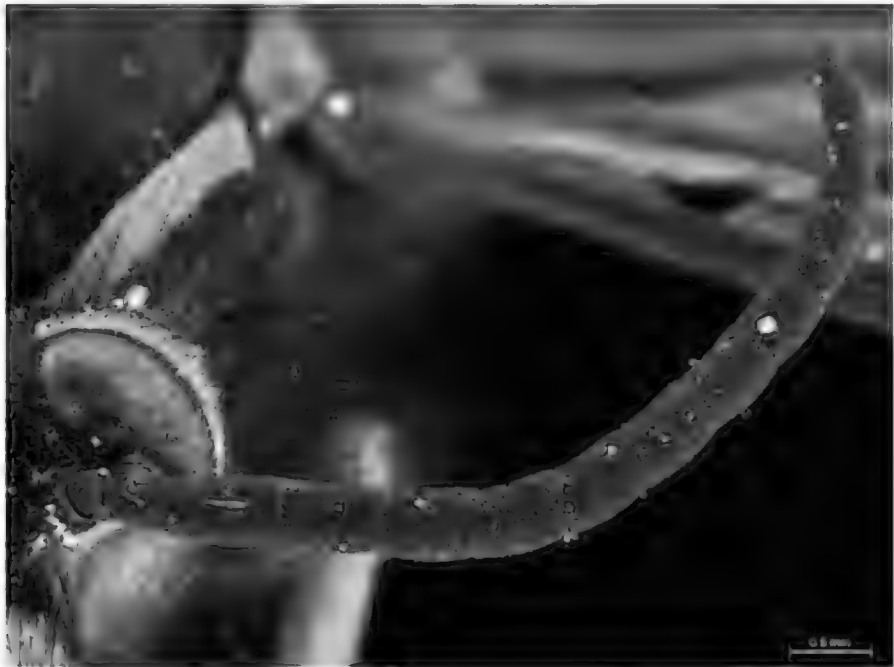
Plate 2



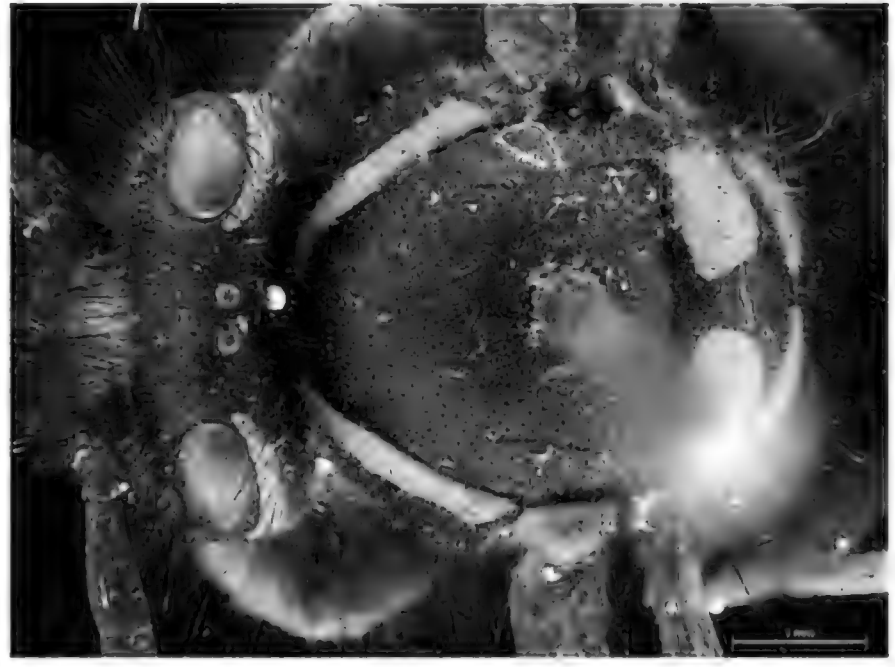
7



8



9



10



11



12

Figs: 7-12: *Vespula nursei* Archer, male. 7: Body, in profile. 8: Head, in frontal view. 9: Antenna. 10: Head and mesosoma in dorsal view. 11: Metasomal tergum. 12: Metasomal sternum.

lateral projection on S6 sharply pointed. In worker, mesoscutal punctures dense with distances between punctures equal to diameter of punctures, less dense on centre and denser on lateral margins; margin behind inner mandibular tooth distinctly concave; occipital carina reaches base of mandible; lower side of second submarginal cell on the medial vein before the point of contact with the second medio-cubital or recurrent vein shorter than the lower side of second submarginal cell after the point of contact with the recurrent vein.

Male: Propodeum rugose, without punctures; genitalia with dorsal terminal process almost absent, indicated by a slight undulation on margin of gonostipes; dorsal terminal process of gonostipes weakly developed; parameral spine gradually narrowing to an apical point; the shaft of aedeagus broad and its apex boat-shaped; T7 deeply notched.

Length: Queen, usually greater than 15.5 mm; Workers, usually less than 15.5 mm.

Material examined: No specimens from the Indian subcontinent were available for our studies. We compared the species description from Archer (2012) with two queens from Foochow China/Kellogg coll. and Yen-ping, China/IV.16.1917/Ac. 5148, and two workers from Yen-ping, China/X.11.1917/Ac. 5148 and VII.10.1917 (New York).

Distribution: India: Meghalaya, Sikkim; Myanmar. Elsewhere: China; Korea; Laos; Russia; Thailand; Vietnam.

6. *Vespula orbata* (du Buysson, 1902)

(Figs. 13-18)

Vespa orbata du Buysson, 1902: 140, female – [India] “Dardjiling” (lectotype Paris); also from Sikkim, China. Additional citations: Archer, 1982: 262, 268 (designation of lectotype).

Vespa minuta Dover, 1925: 304, fig. 9, female – [Myanmar] “Tenasserim” (holotype London). Junior primary homonym of *Vespa minuta* Linnaeus, 1767.

Vespula nuijiangensis Dong and Wang, 2004, in Dong et al., 146, female, figs. 1-5 - [China] “Nuijiang Liuku, Yunnan, Alt. 1 100 m. 25°58’ N. 98°65’ E.” (Yunnan).

Diagnosis: T1 raised basally with a depression behind this elevation (sometimes indistinct in workers). *Female* (queens and workers): outer basal flange of mandible nearly straight. In

queens, propodeum less coarsely rugose and punctures between and interrupting the rugae; ventral metapleuron without strong rugae; backwardly directed postero-lateral projection on S6 sharply pointed. In workers, mesoscutal punctures usually less dense with distances between punctures greater than diameter of punctures, less dense on centre and denser on lateral margins; propodeum not rugose, only punctate; margin behind inner mandibular tooth distinctly concave; occipital carina reaches base of mandible; lower side of second submarginal cell on the medial vein before the point of contact with the second medio-cubital or recurrent vein shorter than the lower side of second submarginal cell after the point of contact with the recurrent vein.

Male: Propodeum punctate, without rugae; genitalia with dorsal terminal process weakly developed but with a distinct projection on margin of gonostipes; the shaft of aedeagus broad and its apex boat-shaped; T7 deeply notched.

Colour (Worker): Body dorsally tricoloured: black, brown and yellow. Head yellowish brown with vertex darker; mesoscutum brown except black posteriorly; scutellum yellowish brown with a black mark in the middle; metanotum largely black and with a narrow brownish yellow line across its anterior margin; mesepisternum and usually the mesepimeron with a brown spot; propodeum black with two lateral brownish yellow spots; fore leg yellowish brown with coxa, trochanter and femur dorsally blackish brown; middle and hind legs blackish brown with apex of femur dorsally and tarsus yellowish; T1, T2 and S2 black or blackish brown with a yellow apical band; T3–T5 black basally and with wider apical yellowish brown bands; T6 wholly yellowish brown; S3–S6 largely yellowish brown.

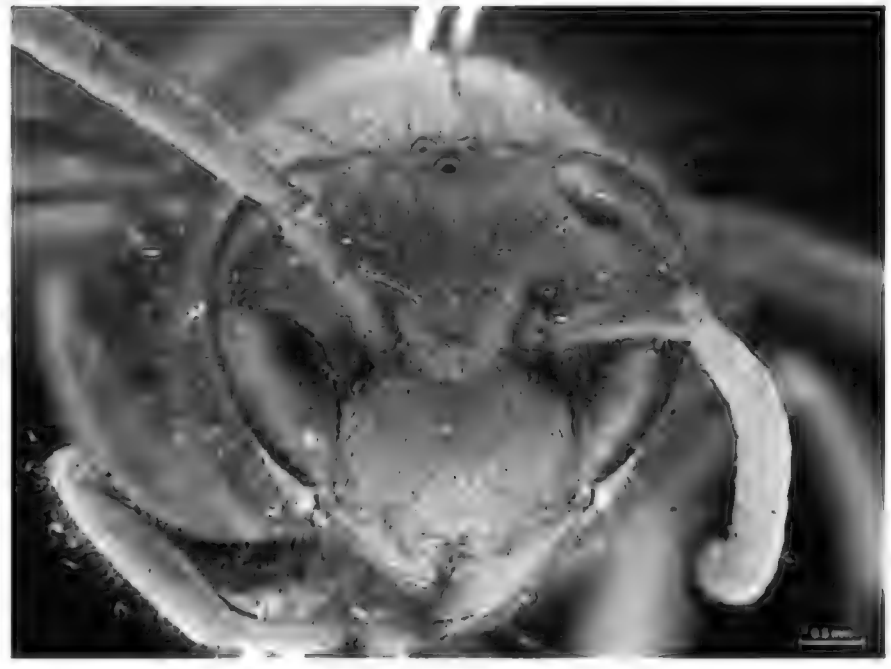
Length (H+M+T1+T2): Worker, 10.5-11.5 mm.

Material examined: INDIA: Nagaland, Mokokchung, 1 worker, 26.iii.1989, Coll. B.C. Das & Party, Regd. No. ZSI/WGRC/I.R-INV.8971; Tuensang, 1 worker, 9.viii.2015, Coll. Lobeno, Regd. No. ZSI/WGRC/I.R-INV.8972. NEPAL: Kathmandu, Sundarjal, 1 worker, date of collection and name of collector unknown, Regd. No. ZSI/WGRC/I.R-INV.8973.

Plate 3



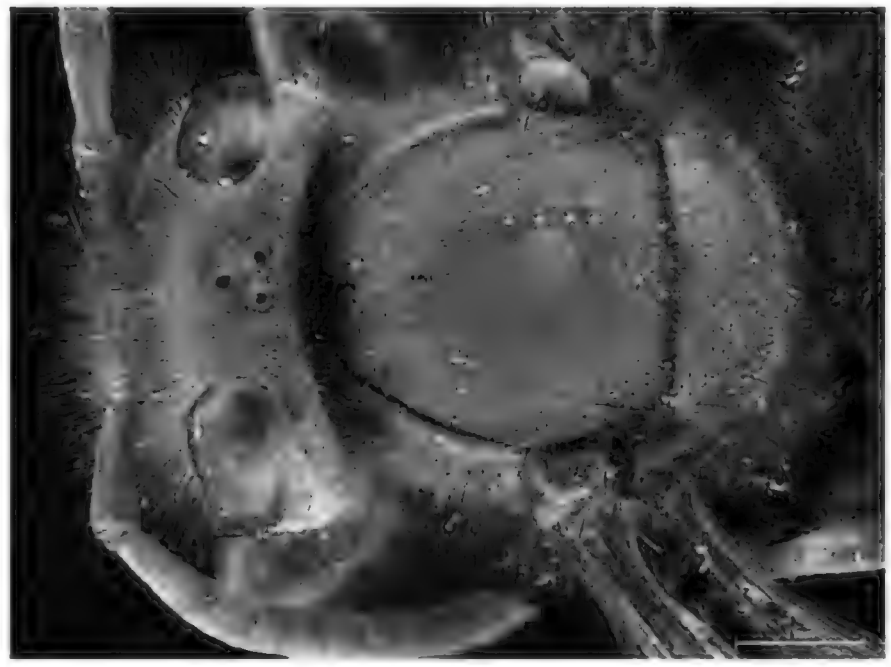
13



14



15



16



17



18

Figs 13-18: *Vespula orbata* (du Buysson), worker. 13: Body, in profile. 14: Head, in frontal view. 15: Clypeus and mandible. 16: Head and mesosoma, in dorsal view. 17: Metasomal tergum. 18: Metasomal sternum.

Distribution: India: Arunachal Pradesh, Nagaland (new record), Sikkim, Uttarakhand, West Bengal; Nepal: Sundarjal; Myanmar. *Elsewhere:* China; Thailand; Laos; Vietnam. This species was previously recorded by other workers from “Uttar Pradesh: Mussoorie” and from “Assam: Mishmi Hills”. The locality Mussoorie presently belongs to Uttarakhand state and the locality Mishmi Hills presently belongs to Arunachal Pradesh.

The *vulgaris* species group

Four species of this species group, namely, *Vespa flaviceps* (Smith, 1870), *V. germanica* (Fabricius, 1793), *V. strutor* (Smith, 1870) and *V. vulgaris* (Linnaeus, 1758) are present in the Indian subcontinent.

7. *Vespula flaviceps* (Smith, 1870)

(Figs. 19-36)

Vespa japonica de Saussure, 1858: 261, female - “Japon.” (Genève). Junior primary homonym of *Vespa japonica* Radoszkowski, 1857.

Vespa flaviceps Smith, 1870: 174, 191, pl. XXI figs. 10, 11, female. “Binsur, Kumaon, North-west Provinces of India” (London).

“*Vespa Lewisii*, Sauss. Guêpes Soc. (MS.)” Smith, 1873: 198. Nomen nudum.

Vespa “*Lewisii*, Sauss. MS.” Cameron, 1903: 280, as a synonym of *Vespa japonica* de Saussure, 1858. Available under Art. 11(e) of the International Code of Zoological Nomenclature.

Vespa Saussurei Schulz, 1906: 231. Replacement name for *Vespa japonica* de Saussure.

Vespa karenkona Sonan, 1929: 137 (key), 148, female. [Taiwan] “Karenkô (3000-6500 ft.)” (Taichung).

Vespa 4-maculata Sonan, 1929: 137 (key), 148, female. [Taiwan] “Arisan” (coll. M. Maki).

Vespa vulgaris var. *flavior* Stolfa, 1934: 49, female. “India: Bagarkote 8000 piedi. Kumaon W. Himalaya... Dal, sopra Dharmasala, 5500 piedi Punjab... Pindi Point, Murree, 7242 piedi. Punjab... Rive del fiume Deo Gad e Foresta S. O. di Pinath, 7 miglia da Kausani Distr. Almora” (type depository unknown).

Vespula japonica pionganensis Giordani Soika, 1976: 287, 290, female (in

subgenus *Vespula*). [Korea] “Za-mo san, 60 km NE from Pyongyang” (Budapest); also from other localities in Korea.

Vespa vulgaris var. *flavior*; Das & Gupta, 1984: 449. Incorrect spelling of *Vespa vulgaris* var. *flavior* Stolfa.

Vespula gracilia Lee, 1986: 201, 203, 206, fig. 2, female. [China] “Zhoushan, Zhejiang Province” (Beijing); also from Fujian.

Diagnosis: Queens: occipital carina not extending to base of mandible, usually extends for less than $\frac{3}{4}$ of lateral length of head; light coloured ocular sinus not deeply penetrated by a medial black projection; black mark on clypeus, if present, usually not reach apical margin. Workers: pale markings ivory-white; light coloured ocular sinus not deeply penetrated by a medial black projection; black mark on clypeus rarely reaches its apical margin. Males: volsella visible in ventral view of gonostipes; light coloured area of ocular sinus not deeply penetrated by a medial black projection, medial margin straight or convex or continuous with the light coloured area of frons; mandible without a triangular black spot at its base; genitalia short, L/W less than one.

Colour: Body markings highly variable in queen and worker. Yellow usually paler, approaching ivory white. Head yellowish except frons and vertex black; clypeus usually yellow, rarely with a basal black line, or this line divided in to three spots; genal band complete; antenna black with scape yellow to yellowish brown ventrally; mesosoma black except following yellow markings: posterior margin of pronotum; spot under wing base; anterior half of scutellum; anterior margin of metanotum; a pair of spots on propodeum; gaster black with yellow bands that are darker than mesosomal markings; legs largely yellowish. Male similar to worker in colouration.

Length: Queen, 13-15 mm. Worker, 8-9 mm. Male, 13-14 mm.

Material examined: INDIA: Himachal Pradesh, Chamba dist., Dalhousie, Bakrota Hills, 1 queen, v-vi.1927, Coll. S.L. Hora, NZC Regd. No. 2280/H3; Shimla, Matiana, 2 queen, 28-30.iv.1907, Coll. N. Annandale, Regd. Nos. ZSI/WGRC/I.R-INV.8974 & 8975; Ahla, 1 queen, vii.1971, Collector

Plate 4



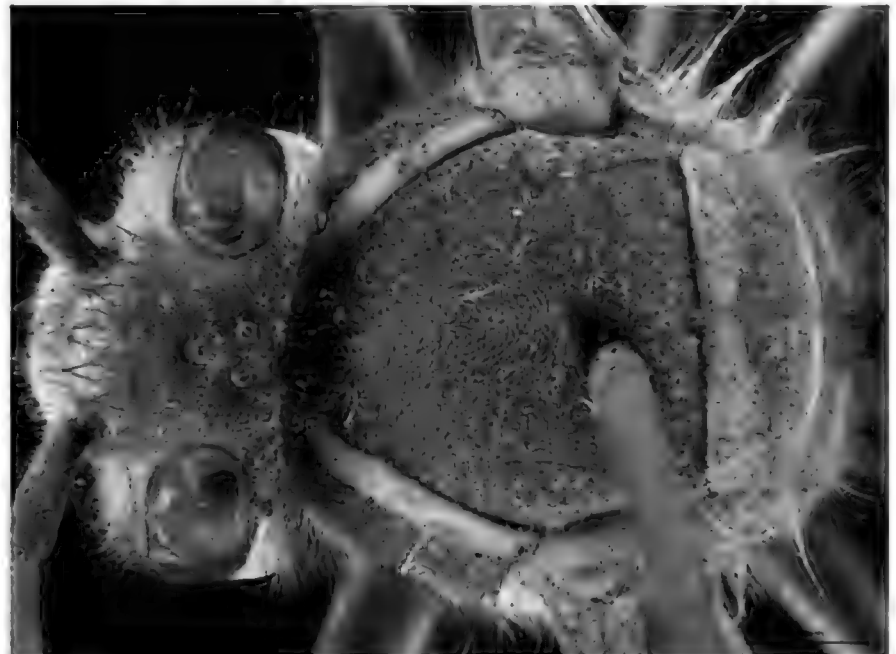
19



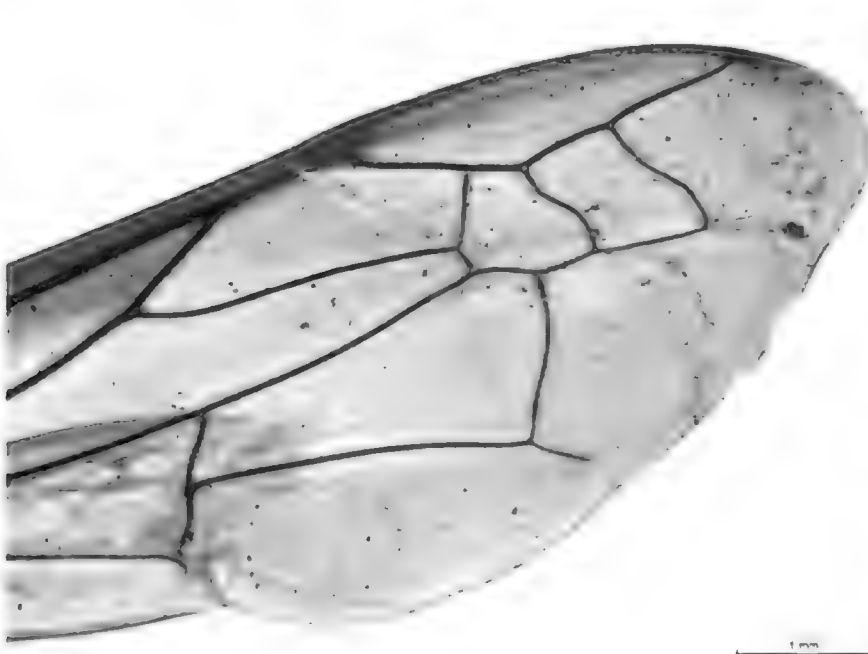
20



21



22



23



24

Figs 19-24: *Vespula flaviceps* (Smith), Queen. 19: Body, in profile. 20: Head, in frontal view. 21: Antenna. 22: Head and mesosoma, dorsal view. 23: Forewing. 24: Metasoma, in dorsal view.

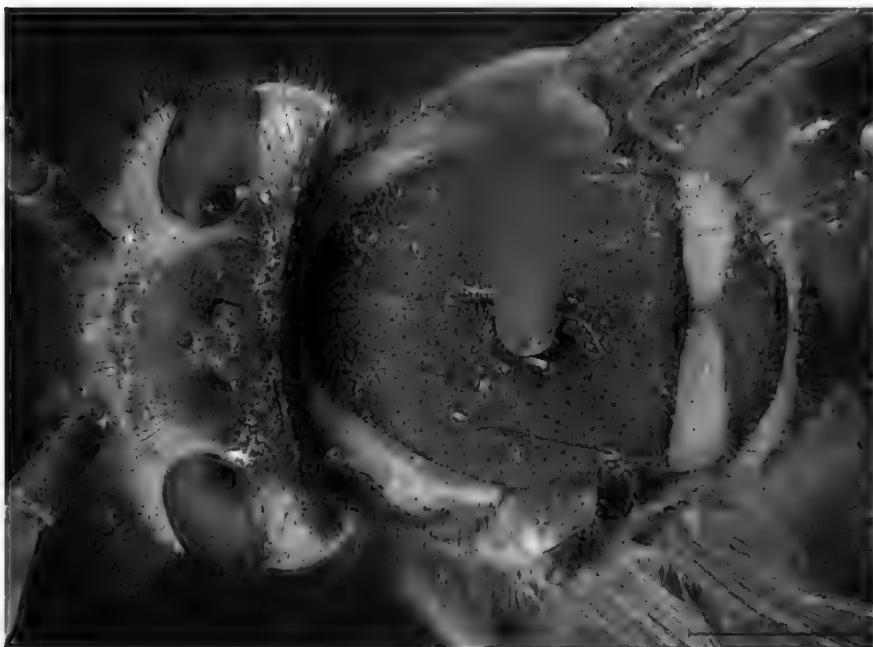
Plate 5



25



26



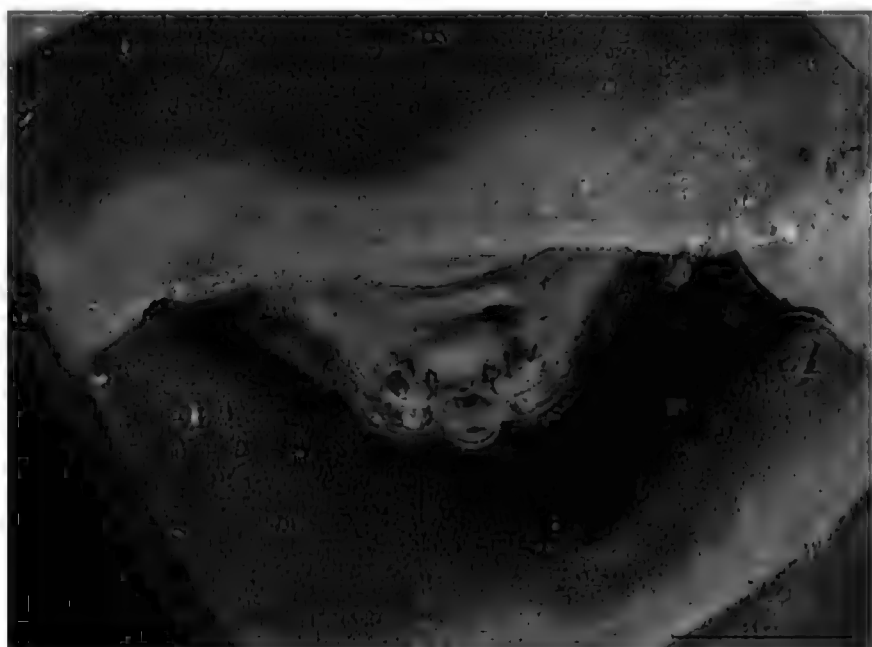
27



28



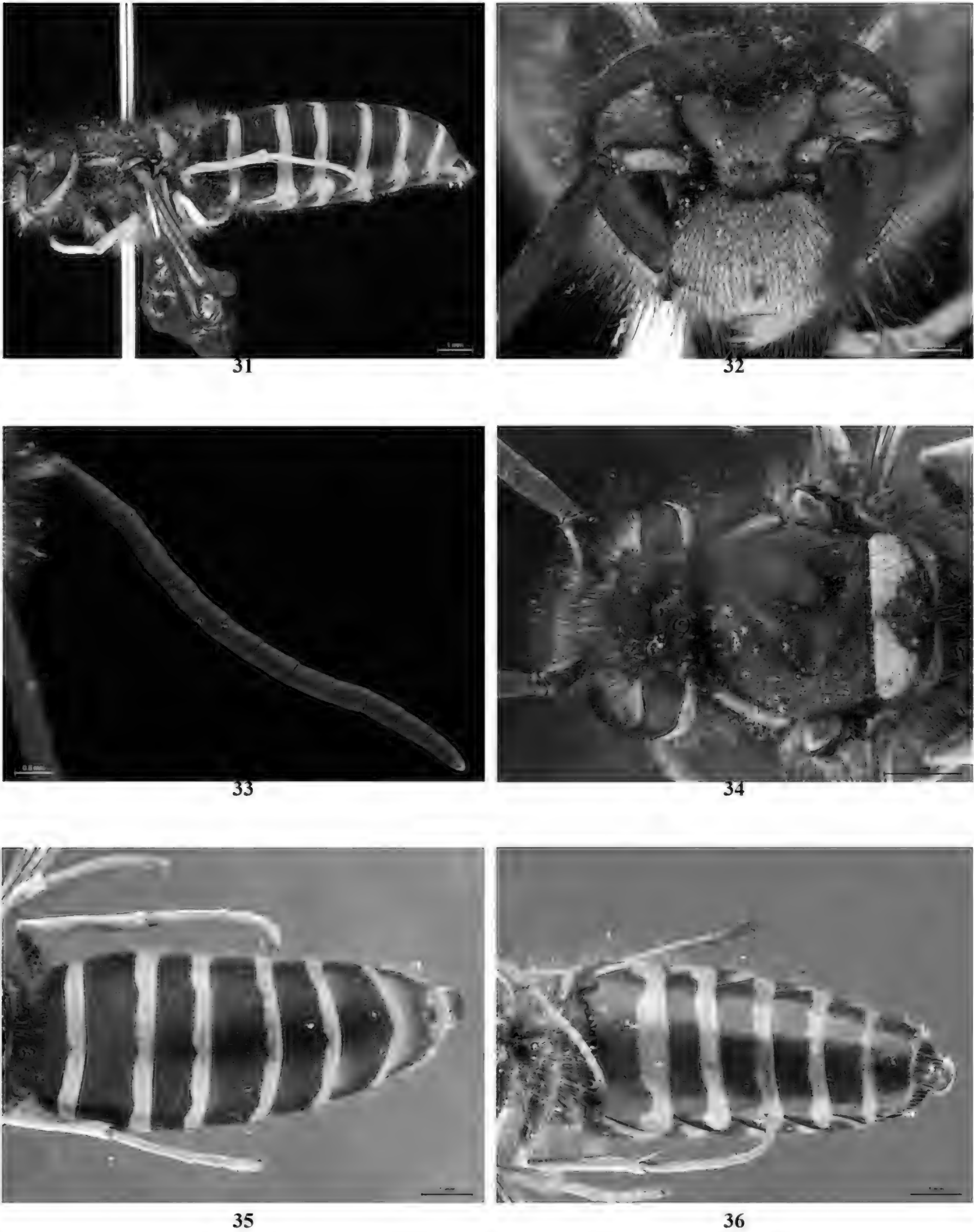
29



30

Figs 25-30: *Vespula flaviceps* (Smith), Worker. 25: Body, in profile. 26: Head, in frontal view. 27: Head and mesosoma, in dorsal view. 28: Metasomal tergum. 29: Metasomal sternum. 30: Parasitisation of Strepsiptera.

Plate 6



Figs 31-36: *Vespula flaviceps* (Smith), male. 31: Body, in profile. 32: Head, in frontal view. 33: Antenna. 34: Head and mesosoma, in dorsal view. 35: Metasomal tergum. 36: Metasomal sternum.

unknown, Regd. No. ZSI/WGRC/I.R-INV.8976; Solan dist., Kandaghat, 1 queen, 6.iv.2011, Coll. D. Banerjee & Party, Regd. No. ZSI/WGRC/I.R-INV.8977; Chamba dist., Khajjiar, 1 queen, 24.iv.2012, Coll. S.K. Ghosh & Party, Regd. No. ZSI/WGRC/I.R-INV.8978; Kullu dist., Manali, 1 queen, 4.vi.2012, Coll. B. Mitra & Party, Regd. No. ZSI/WGRC/I.R-INV.8979; Shimla, 1 worker, 26.ix.1918, Coll. Brunetti, Regd. No. ZSI/WGRC/I.R-INV.8980; Shimla, 1 worker, 11.x.1974, Coll. L.K. Ghosh & Party, Regd. No. ZSI/WGRC/I.R-INV.8981; Solan, 1 worker, 14-17.vi.1979, Coll. V.K. Gupta & Party, Regd. No. ZSI/WGRC/I.R-INV.8982; Chamba dist., Dalhousie, 2 workers, 10.xi.2010, Coll. G.P. Mandal & Party, Regd. Nos. ZSI/WGRC/I.R-INV.8983 & 8984. Jammu & Kashmir, Srinagar, 1 male, 20.x.1976, Coll. S.K. Gupta, Regd. No. ZSI/WGRC/I.R-INV.9084; Shopian district, Heff village, apple orchards, 1 worker, 9.ix.2017, Coll. Altaf Hussain, Regd. No. ZSI/WGRC/I.R-INV.10018. Manipur, Imphal Valley, 3 workers, 24.xii.1945, Coll. M.L. Roonwal, Regd. Nos. ZSI/WGRC/I.R-INV.9085–9087. Uttarakhand, Nainital, 1 male, 1908, Coll. R.E. Lloyd, Regd. No. ZSI/WGRC/I.R-INV.8985; Chamoli dist., Lohba, 1 male, 17.iv.1914, Coll. Tytler, Regd. No. ZSI/WGRC/I.R-INV.8986; Dehradun dist., Mussoorie, 1 worker, 15.vi.1930, Coll. B.N. Chopra, Regd. No. ZSI/WGRC/I.R-INV.8987; Pauri Garhwal dist., Kiwarsh, 1 worker, 17.i.1966, Coll. T.D. Soota, Regd. No. ZSI/WGRC/I.R-INV.8988; Solan dist., Dagshai, 1 worker, 10.xi.1970, Coll. Kailash Chandra & Party, Regd. No. ZSI/WGRC/I.R-INV.8989; Nainital, 4 workers, 2-10.x.1978, Coll. V.K. Gupta, Regd. Nos. ZSI/WGRC/I.R-INV.8990–8993; Uttarkashi Dist., Pilang, 5 workers, 18.xi.1999, Coll. B.C. Das & Party, Regd. Nos. ZSI/WGRC/I.R-INV.8994–8998; Uttarkashi Dist., Bhatwari, 6 workers, 19.xi.1999, Coll. B.C. Das & Party, Regd. Nos. ZSI/WGRC/I.R-INV.8999–9004; Uttarkashi Dist., Bhatwari, 6 workers, 19.xi.1999, Coll. B.C. Das & Party, Regd. Nos. ZSI/WGRC/I.R-INV.8999–9004; Rudraprayag Dist., Chopta, 1 worker, 21.xi.1999, Coll. B.C. Das & Party, Regd. No. ZSI/WGRC/I.R-INV.9005; Almora Dist., Ranikhet, 1 worker, 27.xi.1999, Coll. B.C. Das & Party, Regd. No. ZSI/WGRC/I.R-INV.9006; Pithoragarh Dist., Berinag, 1

worker & 1 male, 30.iii.1999, Coll. B. Mitra & Party, Regd. Nos. ZSI/WGRC/I.R-INV.9007 & 9008; Uttarkashi Dist., Jaspur, 1 worker, 28.viii.2006, Coll. B. Mitra & Party, Regd. No. ZSI/WGRC/I.R-INV.9009. West Bengal, Jalpaiguri Dist., Bangrakote, 1 queen, 2.v.1914, Coll. Tytler, NZC Regd. No. 1099/H3.

Ethology: Parasitic association of Strepsiptera was observed in one worker specimen collected in Himachal Pradesh. The female strepsipteran extruded out from the third tergite of the wasps as seen in the figure 30.

Distribution: India: Assam, Himachal Pradesh, Jammu & Kashmir, Manipur, Meghalaya, Punjab, Sikkim, Uttarakhand, West Bengal (new record); Myanmar; Nepal; Pakistan. Elsewhere: China; Japan (including Amami Is. In Ryukyu Is.); Korea; Laos; Russia; Taiwan; Thailand; Vietnam.

8. *Vespula germanica* (Fabricius, 1793) (Figs. 37-48)

?*Vespa maculata* Scopoli, 1763, 312, [Slovenia] “Carnioliae” (destroyed?). Junior primary homonym of *Vespa maculata* Linnaeus, 1763.

?*Vespa macularis* Olivier, 1792: 695. Unjustified emendation of *Vespa maculata* Scopoli.

Vespa germanica Fabricius, 1793: 256. [Germany] “Kiliae” (type depository unknown).

Diagnosis: Queen and Worker: Margin behind third mandibular tooth distinctly concave; outer basal flange of mandible strongly curved; occipital carina reaching mandibular base; apical margin of clypeus concave and depressed medially; mesosomal punctures indistinct; propodeum not rugose.

Colour: Body black with yellow markings as follows: mandible except teeth brown; clypeus; shield on lower frons; ocular sinus (in queen, yellow mark on frons connected to that of ocular sinus); area between antennal toruli and inner eye margin; temple; broad mark on pronotum; two marks on either sides of scutellum and metanotum; triangular mark on mesopleuron near to forewing; small spots on either sides of propodeum; tegula; mark behind base of hindwing; mark on mid and hind coxa; apical half of all femora; all tibia and tarsus entirely; dorsal side of T1 except

extended black mark at middle (large) and at sides (small); T2-T5 except at base black which triangularly extends towards apex at middle and separate small spots on either sides; S2-S5 except basal black area which extends to apex at middle and both sides; T6 and S6 entirely.

Length: Queen, 14.5 mm; Worker, 8-12 mm.

Material examined: INDIA: Himachal Pradesh, Lahaul Spiti district, Chango, 1 worker, 14.ix.2011, Coll. G. Srinivasan & Party, Regd. No. ZSI/WGRC/I.R-INV.9553; Lahaul Spiti district, Pao, 1 worker, 21.ix.2013, Coll. V.D. Hegde & Party, Regd. No. ZSI/WGRC/I.R-INV.9554. Jammu & Kashmir, Ladakh, Kargil, 1 worker, 15.vi.1973, Coll. V.K. Gupta & Party, NZC Regd. No. 16574/H3; Ladakh, Leh, 98 workers, 19-23.vi.1973, Coll. V.K. Gupta & Party, NZC Regd. Nos. 16575/H3–16672/H3; Ladakh, Chusul, 1 worker, 7.ix.2008, Coll. A.K. Sanyal & Party, Regd. No. ZSI/WGRC/I.R-INV.9555; Ladakh, Nider, 1 worker, 8.ix.2008, Coll. A.K. Sanyal & Party, Regd. No. ZSI/WGRC/I.R-INV.9556; Kargil district, Panikhar, 2 workers, 20.ix.2008, Coll. A.K. Sanyal & Party, Regd. Nos. ZSI/WGRC/I.R-INV.9557 & 9558. PAKISTAN: Chitral, 1 queen & 1 worker, 9.ix.1929, Coll. B.N. Chopra, Regd. No. ZSI/WGRC/I.R-INV.9559 (queen) & NZC Regd. No. 1096/H3 (worker).

Distribution: India: Himachal Pradesh (new record), Jammu & Kashmir; Nepal; Pakistan. Elsewhere: Afghanistan; Albania; Algeria; Armenia; Argentina (Introduced); Ascension Island (Introduced); Australia (Introduced); Austria; Azerbaijan; Belarus; Belgium; Bosnia & Herzegovina; Bulgaria; Canada (Introduced); Chile (Introduced); China; Croatia; Czech Republic; Denmark; Estonia; Finland; France; Georgia; Germany; Greece; Hungary; Iceland (Introduced); Iran; Iraq; Ireland; Israel; Italy; Jordan; Kazakhstan; Korea; Kyrgyzstan; Lebanon; Liechtenstein; Lithuania; Luxembourg; Macedonia; Malta; Mayotte; Moldova; Mongolia; Morocco; Netherlands; New Zealand (Introduced); Norway; Poland; Portugal; Romania; Russia; Sakhalin Island; Scotland; Serbia; Slovakia; Slovenia; South Africa (Introduced); Spain (including Canary Islands); Sweden; Switzerland; Syria; Taiwan; Tajikistan;

Tunisia; Turkey; Turkmenistan; U.K.; Ukraine; U.S.A. (Introduced); Uzbekistan.

9. *Vespula structor* (Smith, 1870)

(Figs. 49-60)

Vespa structor Smith, 1870, in Horne and Smith, 191, pl. XXI fig. 12, female – “Binsur, Kumaon, North-west Provinces of India” (London).

Vespa orbata var. *aurulenta* du Buysson, 1905: 579, female, “Chine, Mou-pin ... ; Amur” (Paris, Wien?). NEW SYNONYMY.¹

Vespa structrix Schulz, 1906: 231. Unjustified emendation of *Vespa structor* Smith.

Vespula gongshanensis Dong 2005, in Dong *et al.*: 65, female, male – “China, Gongshan, Yunnan Province, alt. 2,950” (holotype female Yunnan).

Diagnosis: Queen: Tri-coloured (yellow, black and brown); brown colour particularly visible on pronotum, T2 and S2-S4; scutellum and metanotum black, without yellow spots, at most with brown markings; clypeus yellow to orange without a black median mark; oculo-malar space longer, HW/OMS less than 18; margin behind third mandibular tooth straight or at most slightly concave; occipital carina extend to base of mandible. Workers: Light colour of gastral terga orange yellow; dorsal surface of T1 without or almost without black marking; metanotum without a yellow mark.

Material examined: INDIA: Arunachal Pradesh, West Kameng district, Bomdila, 1 worker, 30.viii.1998, Coll. A.R. Lahiri & Party, Regd. No. ZSI/WGRC/I.R-INV.10234; Jammu & Kashmir, Srinagar, 1 worker, 29.ix.1978, Coll. Bindu, Regd. No. ZSI/WGRC/I.R-INV.10235; Sikkim, exact collection locality and date of collection unknown, 2 workers, Coll. A.V. Knyvett, Regd. Nos. ZSI/WGRC/I.R-INV.10236 & 10237; Uttarakhand, Uttar Kashi district,

¹ One of us (JMC) has seen a specimen from Mou-pin in Paris, with a determination label by du Buysson, a label reading “Type/examined by/Dr. J. v. d. Vecht 1956” and a determination label as *Paravespula structor* Sm. ab. by I. H. Yarrow. 1958. The determination appears to be correct, which represents revised synonymy for this taxon. JMC checked for material in Vienna, but only found an empty labeled space in the collection.

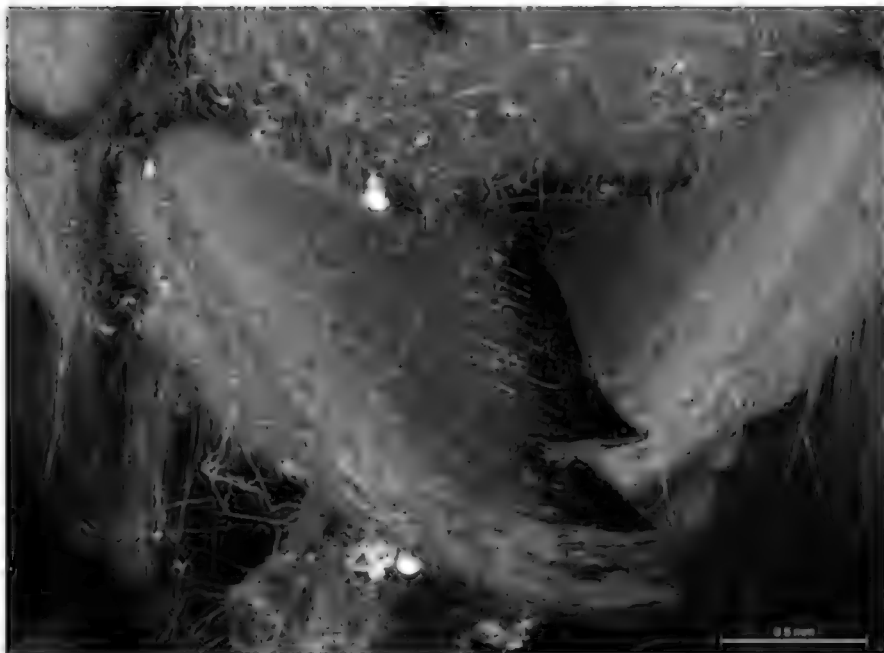
Plate 7



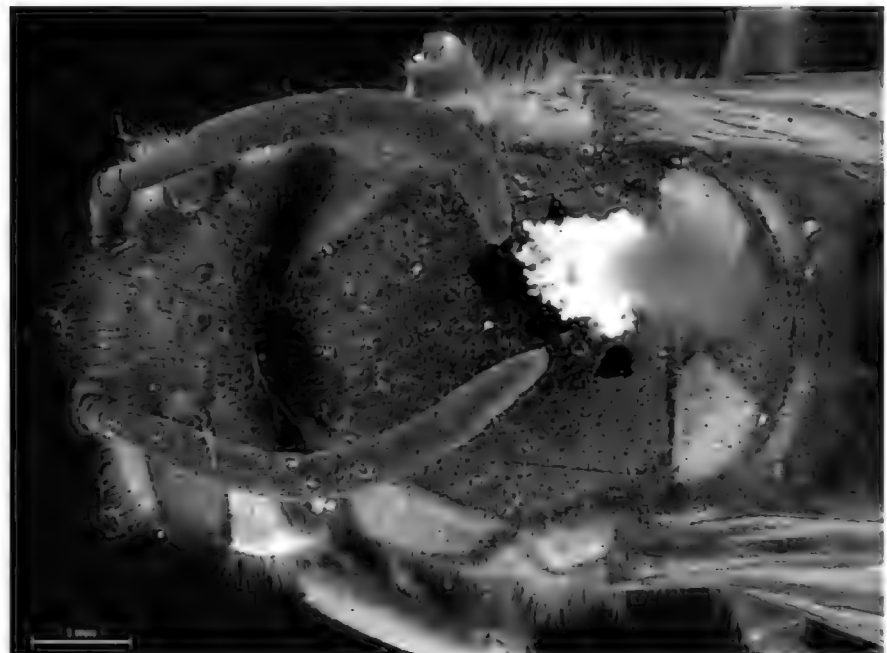
37



38



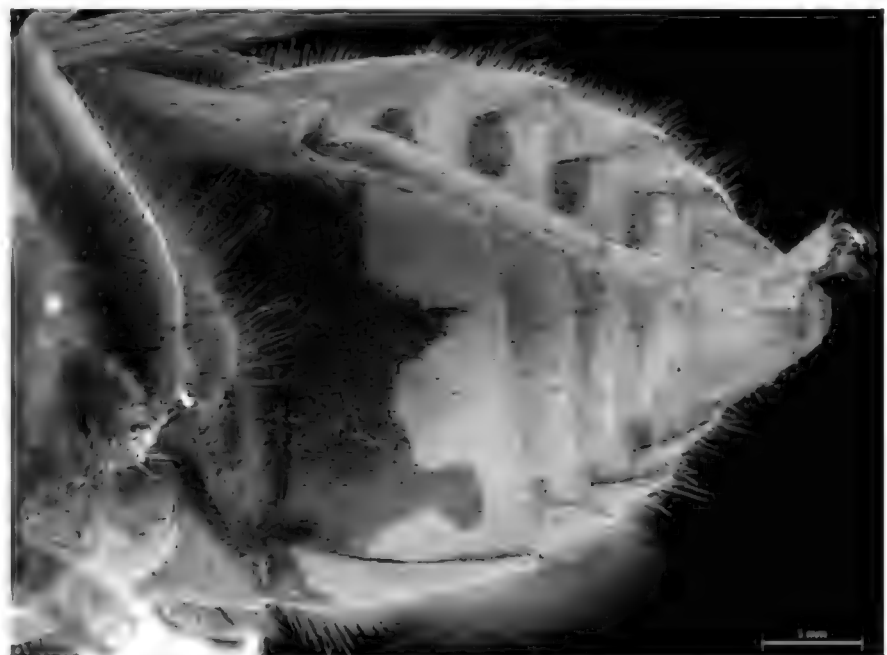
39



40



41



42

Figs 37-42: *Vespula germanica* (Fabricius), Queen. 37: Body, in profile. 38: Head, in frontal view. 39: Mandible. 40: Head and mesosoma dorsal view. 41: Metasomal tergum. 42: Metasomal sternum.

Plate 8



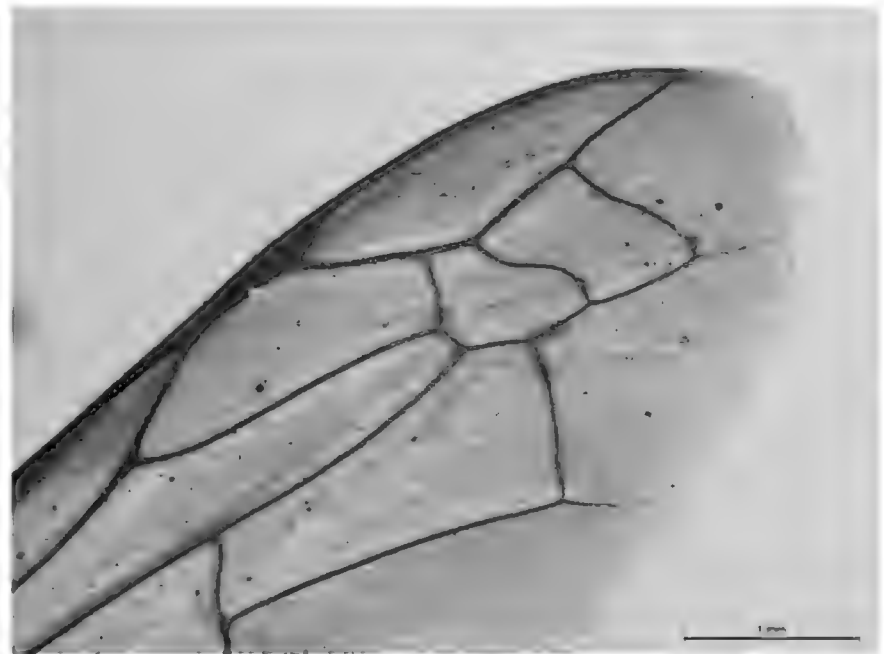
43



44



45



46



47



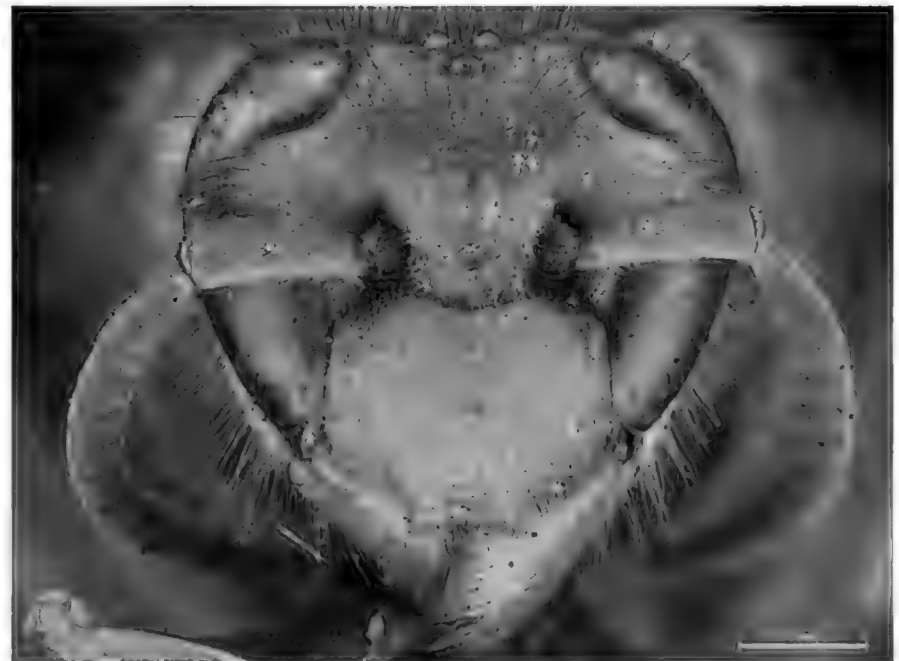
48

Figs43-48: *Vespula germanica* (Fabricius), Worker. 43: Body, in profile. 44: Head, in frontal view. 45: Head and mesosoma, in dorsal view. 46: Apical half of forewing. 47: Metasomal tergum. 48: Metasomal sternum.

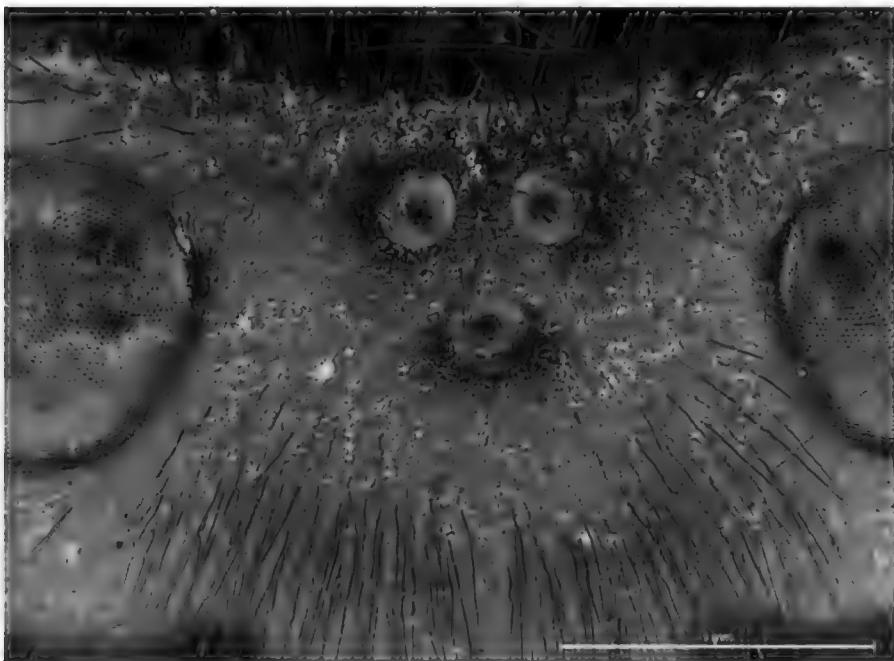
Plate 9



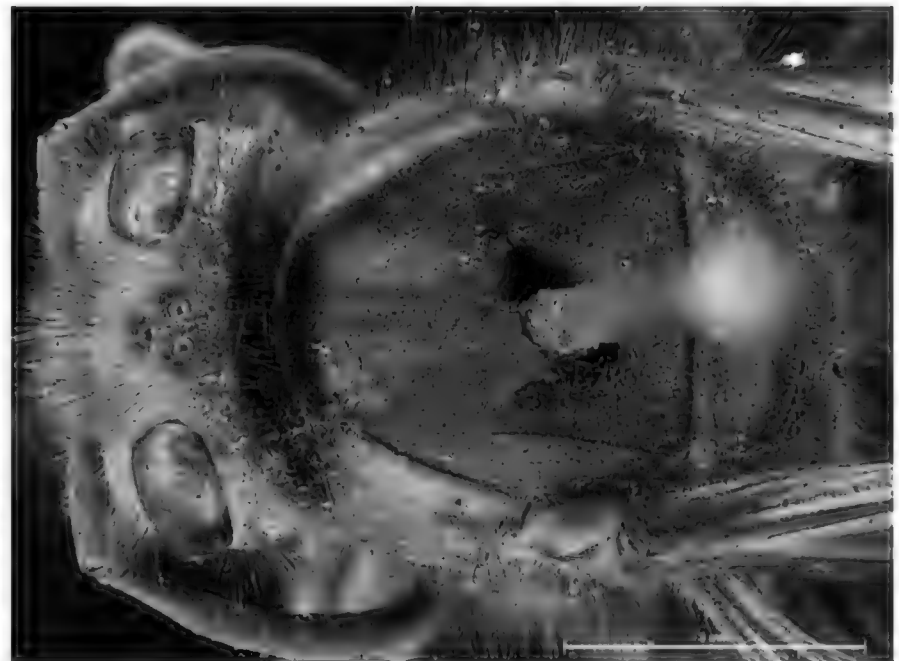
49



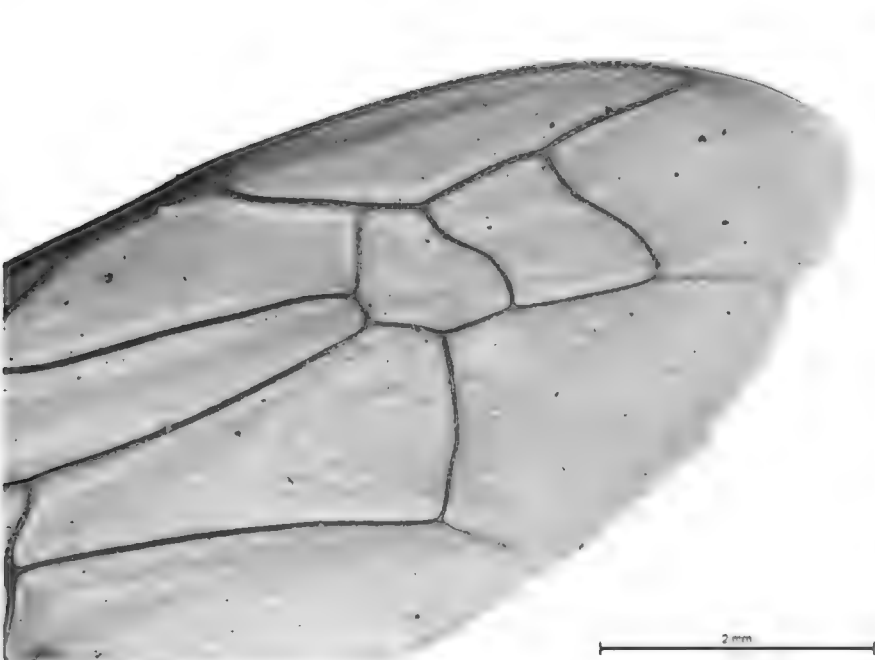
50



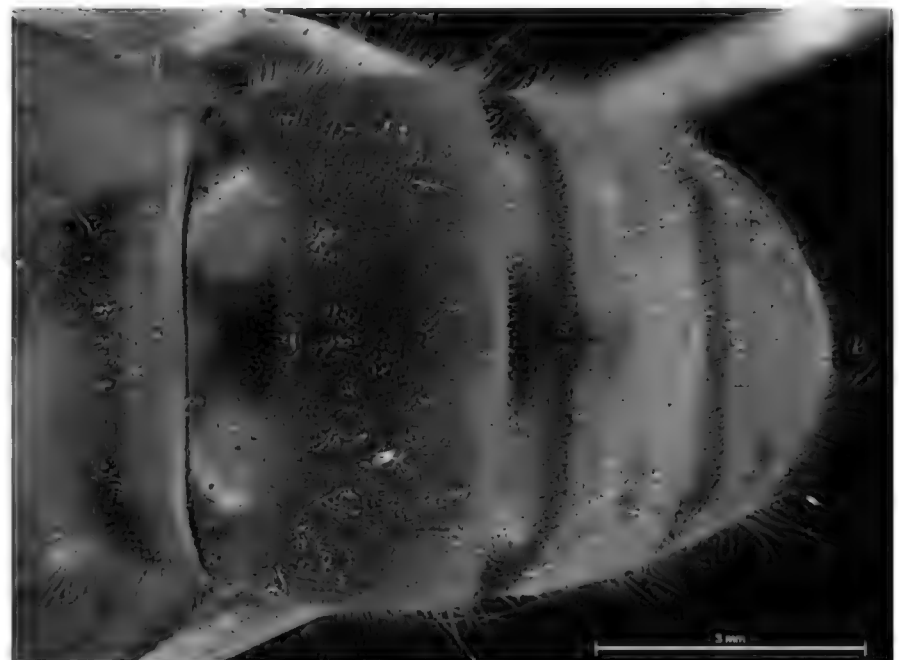
51



52



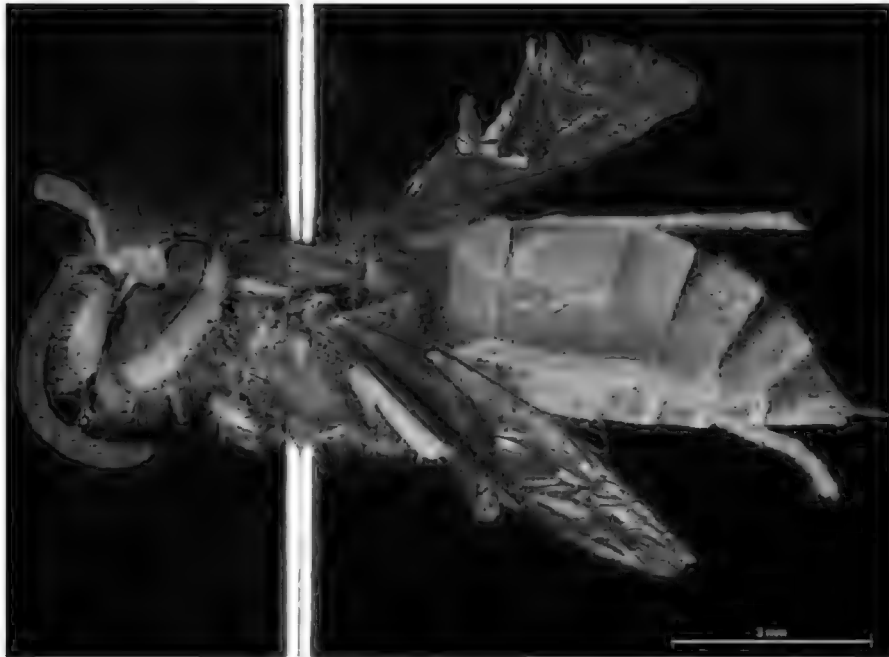
53



54

Figs 49-54: *Vespula structor* (Smith), Queen. 49: Body, in profile. 50: Head, in frontal view. 51: Ocellar area. 52: Head and mesosoma, in dorsal view. 53: Apical half of forewing. 54: Metasoma, in dorsal view.

Plate 10



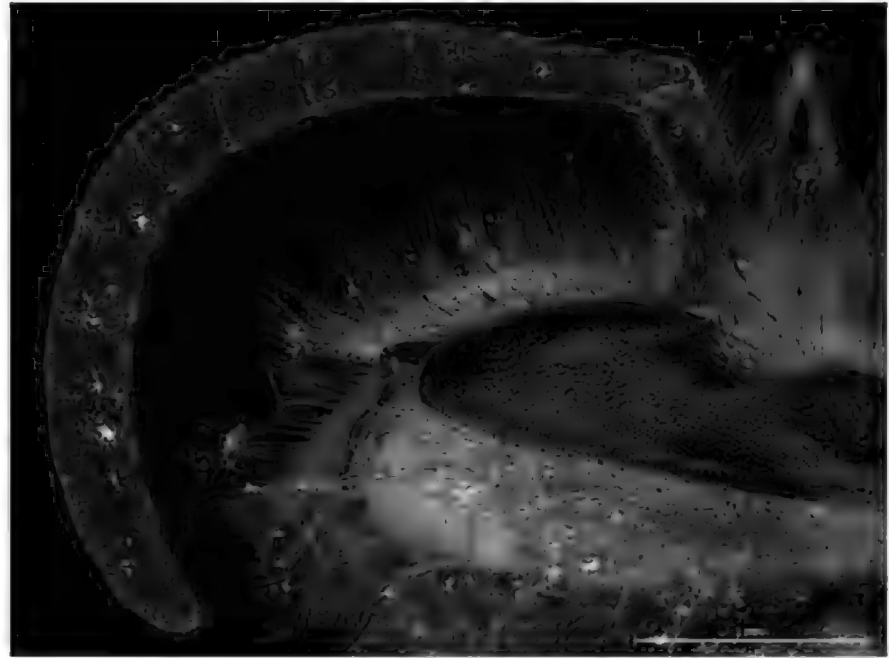
55



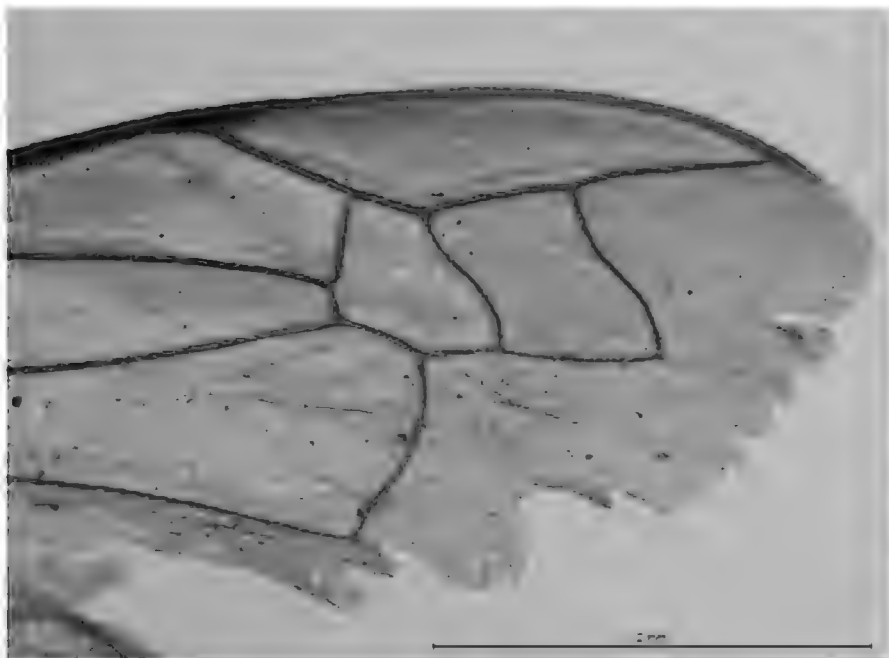
56



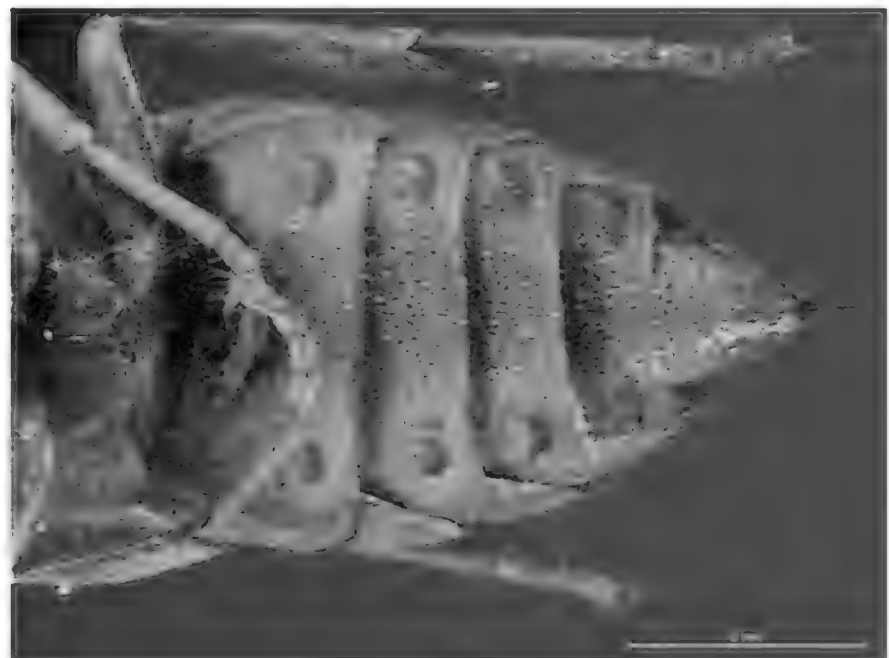
57



58



59



60

Figs 55-60: *Vespula structor* (Smith), Worker. 55: Body, in profile. 56: Body, in dorsal view. 57: Head, in frontal view. 58: Antenna. 59: Apical half of forewing. 60: Metasomal sternum.

Plate 11



61



62



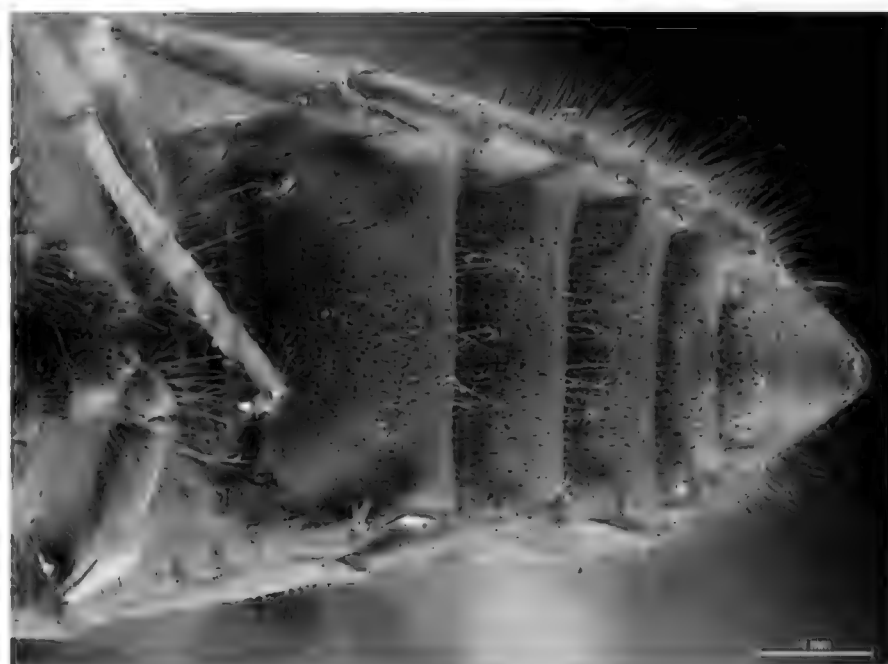
63



64



65



66

Figs 61-66: *Vespula vulgaris* (Linnaeus), Worker. 61: Body, in dorsal view. 62: Head, in frontal view. 63: Head and mesosoma, in dorsal view. 64: Wings. 65: Metasomal tergum. 66: Metasomal sternum.

Syana Chatti, 4 queens & 1 worker, 14.xi.2003, Coll. S.K. Chakraborty & Party, Regd. Nos. ZSI/WGRC/I.R-INV.10238-10242.

Distribution: India: Arunachal Pradesh (new record), Assam, Jammu & Kashmir, Himachal Pradesh, Sikkim, Uttarakhand, West Bengal; Nepal; Myanmar. Elsewhere: China; Laos;

Thailand.

10. *Vespula vulgaris* (Linnaeus, 1758)
(Figs. 61-66)

Vespa vulgaris Linnaeus, 1758: 572, “in Europa” (Lectotype female, Linnaean Society, London). Additional citation: Day, 1979: 77 (designation of lectotype).

Vespa sexcincta Panzer, 1799: 1, fig. 1, male – “Viennae Austr.” (destroyed).

Vespa vulgaris var. *pseudogermanica* Stofa, 1932: 26 (key), female – [Italy] “Lago superior di Weissenfels (Tarvisio Senosecchia” (type depository unknown).

Vespa mixta “Schenck” Edwards, 1980: 363. Nomen nudum.

Vespula rufosignata Eck, 1998: 299, female, figs. 1A, C, 2 - “India: Kashmir, Gulmarg, 2900 m” (type depository not stated; London); also from two other localities.

Vespula vulgaris vetus Eck, 1999: 309, 329, female, male - “China, Quinghai Prov., Datong-Tal, 120 km NE Xinging, 2360 m” (holotype female Dresden); also from five other localities.

Vespula yunlongensis Dong and Wang, 2003, in Dong *et al.*: 212, fig. 1, female [?] - “Yunnan, China” (Yunnan).

Diagnosis: Worker. Occipital carina complete, extending from vertex to mandible, but disappear for a short distance near to mandible and then reappear and reaching to mandible; yellow area of ocular sinus with a concave medial margin and widely separated from yellow shield of frons; margin behind third mandibular tooth almost straight.

Colour: Body black with yellow markings as follows: mandible except teeth brown; clypeus except an anchor-shaped black mark; shield on lower frons; ocular sinus; area between antennal toruli and inner eye margin; temple except wide black interruption; narrow mark on pronotum; two marks on either sides of scutellum and metanotum; triangular mark on mesopleuron; spots on either sides of propodeum; tegula; small mark behind base of hindwing; mark on mid and hind coxa; apical half of all femora; all tibia and tarsus entirely; apical half of dorsal side of T1, band medially invaginated; apex of T2-T5, anterior side with

irregular zigzag margin; apex of S2-S5 with almost regular band, narrowed towards sides; outer margin of T6; visible part of S6 almost entirely.

Length: worker, 12.5-13.5 mm.

Material examined: INDIA: Himachal Pradesh, Kinnaur district, Sangla, 1 worker, 17.x.2006, Coll. R. Babu & Party, Regd. No. ZSI/WGRC/I.R-INV.9560; Jammu & Kashmir, Pahalgam, 2 workers, 1-2.x.1978, Coll. Bindu, Regd. Nos. ZSI/WGRC/I.R-INV.9561 & 9562.

Distribution: India: Himachal Pradesh (new record), Jammu & Kashmir; Pakistan. Elsewhere: Albania; Argentina (Introduced); Australia (Introduced); Austria; Azerbaijan; Belarus; Belgium; Bosnia & Herzegovina; Bulgaria; Chile (Introduced); China; Croatia; Czech Republic; Denmark; Estonia; Finland; France; French Polynesia (Introduced); Georgia; Germany; Greece; Hungary; Iceland (Introduced); Iran; Ireland; Israel; Italy; Japan; Kazakhstan; Korea; Kurile Islands; Kyrgyzstan; Latvia; Liechtenstein; Lithuania; Luxemburg; Macedonia; Mexico; Moldova; Mongolia; Netherlands; New Zealand (Introduced); Norway; Poland; Portugal; Romania; Russia; Serbia; Slovakia; Slovenia; South Africa (Introduced); Spain; Sweden; Switzerland; Syria; Turkey; U.K.; Ukraine.

Acknowledgements

The authors are grateful to Dr. Kailash Chandra, Director, Zoological Survey of India, Kolkata, and Dr. P.M. Sureshan, Officer-in-Charge, Western Ghats Regional Centre, Zoological Survey of India, Kozhikode, for providing facilities and encouragement.

References

- André, E. 1884. Species des Hyménoptères d'Europe et d'Algerie, 2, Vespinae. Beaune.
- Archer, M.E. 1981. The Euro-Asian species of the *Vespula rufa* Group (Hymenoptera, Vespidae) with descriptions of two new species and one new subspecies. Kontyû 49: 54-64.
- Archer, M.E. 1982. A revision of the subgenus *Rugovespula* nov. of the genus *Vespula* (Hymenoptera, Vespidae). Kontyû 59: 261-269.

- Archer, M.E. 2007. Taxonomy, distribution and nesting biology of species of the genus *Vespula* or the *Vespula rufa* species group (Hymenoptera, Vespidae). *Entomologist's Monthly Magazine* 143: 35-48.
- Archer, M.E. 2012. *Vespine wasps of the World. Behaviour, Ecology & Taxonomy of the Vespinae*. Monograph series, volume 4, 352 pp. Published by Siri Scientific Press, Manchester, UK.
- Ashmead, W.H. 1902. Classification of the fossorial, predaceous and parasitic wasps, or the Superfamily Vespoidea. Paper no. 6. Family XXVIII. Vespidae. *Canadian Entomologist* 34: 163-166.
- Blüthgen, P. 1938. Systematisches Verzeichnis der Faltenvespen Mitteleuropas, Skandiniens und Englands. *Konowia* 16: 270-295.
- Blüthgen, P. 1943. Taxonomische und biologische Notizen über paläarktische Faltenwespen (Hym., Ves.). *Stettiner Entomologische Zeitung* 104: 149-158.
- Buysson, R. du. 1902. Descriptions de trois guêpes nouvelles. *Bulletin de la Société entomologique de France*: 140-141.
- Buysson, R. du. 1905. Monographie des guêpes ou *Vespa*. *Annales de la Société entomologique de France* 73: 485- 556., 565- 634.
- Cameron, P. 1903. Descriptions of four species of *Vespa* from Japan. *Entomologist* 36: 278-281.
- Dalla Torre, K.W. von. 1894. *Catalogus Hymenopterorum* 9, Vespidae (Diploptera), Leipzig, 181 pp.
- Dalla Torre, K. W. von. 1904. *Vespidae, Genera Insectorum* 19: 1-108.
- Das, B.P. and Gupta, V.K. 1984. A catalogue of the families Stenogastridae and Vespidae from the Indian Subregion (Hymenoptera: Vespoidea). *Oriental Insects* 17: 395-464. <http://dx.doi.org/10.1080/00305316.1983.10433698>
- Das, B.P. and Gupta, V.K. 1989. The social wasps of India and the adjacent countries (Hymenoptera: Vespidae). *Oriental Insects Monograph* 11: 1-292.
- Day, M.C. 1979. The species of Hymenoptera described by LINNAEUS in the genera *Sphex*, *Chrysis*, *Vespa*, *Apis* and *Mutilla*. *Biological Journal of the Linnean Society* 12: 45-84.
- Dong, D., Wang, Y., He, Y. and Wang, R. 2002. A New Species of *Vespula* (Hymenoptera; Vespidae) from Yunnan, China. *Journal of the Southwest Agricultural University* 24(5): 396-397.
- Dong, D., He, Y., Wang, Y., and Wang, R. 2003. A New Species of *Vespula* (Hymenoptera: Vespidae) from Yunnan, China. *Journal of the Southwest Agricultural University* 25(3): 212-213.
- Dong, D., Wang, Y. He, Y. and Wang, R. 2004. A New Species of *Vespula* (Hymenoptera; Vespidae) from Nujiang of Yunnan Province. *Journal of Southwest Agricultural University (Natural Science)* 26(2): 146-147.
- Dong, D., Liang, X., Wang, Y. and He, Y. 2005. A New Species of *Vespula* from Gongshan, Yunnan, China. *Entotaxonomia* 27(1): 65-68.
- Dover, C. 1925. Further notes on the Indian Diplopterous wasps. *The Journal of the Asiatic Society of Bengal, new series* 20: 289-305.
- Eck, R. 1998. Eine neue Art der *Vespula vulgaris* Gruppe aus Asien (Insecta; Hymenoptera; Vespidae). *Reichenbachia* 32(43): 299-302.
- Eck, R. 1999. Zur Populationsgliederung und Zoogeographie von *Vespula vulgaris* Faktoren der intraspezifischen Merkmalsänderungen (Insecta: Hymenoptera: Vespidae). *Entomologische Abhandlungen, Staatliches Museum für Tierkunde, Dresden* 58: 309-342.
- Edwards, R. 1980. *Social Wasps*. Rentokil Limited, East Grinstead, 385 pp.
- Fabricius, J.C.F. 1793. *Entomologia Systematica Emendata et acuta. Secundum, Classes, Ordines, Genera, Species, Adiectis Synonymis, Locis, Observationibus, Descriptionibus* 2. Hafniae, viii+519pp.
- Giordani Soika, A. 1976. Vespidae ed Eumenidae raccolti in Corea (Hymenoptera). *Annales d'Histoire Naturelle de Hongrie* 68: 287-293.
- Griffin, F.J. 1939. On the dates of publication of de Saussure (H. de): Etudes sur la famille des Vespidae 1-3. 1852-1858. *Journal of the Society for the Bibliography of natural History* 1: 211-212.
- Gussakovskii, V. 1932. Verzeichnis der von Herrn Dr. Malaise im Ussuri und Kamtschatka gesammelten aculeaten

- Hymenoptera. Arkiv för Zoologi 24 A(10):1-66.
- Horne, C. and Smith, F. 1870. Notes on the habits of some hymenopterous insects from the north-west provinces of India. With an appendix, containing descriptions of some new species of Apidae and Vespidae collected by Mr. Horne: by Frederick Smith, of the British Museum. Transactions of the Zoological Society of London 7: 161-196, pls. 19-22.
- Lee, T.S. 1986. Notes on the genus *Vespula* from China (Hymenoptera: Vespidae). Sinozoologica 10(4): 201-206.
- Linnaeus, C. 1758. *Systema Naturae*, (10th Ed.) Vol. 1. (Laurentii Salvii, Holmiae).
- Olivier, G.A. 1791-92. Encyclopedie methodique histoire naturelle. Insectes 6. Paris (Panckoucke): 704 pp.
- Panzer, G.W.F. 1799. Faunae Insectorum Germanicae, Heft 63: 1-2.
- Radoszkowski, O. 1861. Beschreibung einiger neuen Hymenopteren-Arten. Horae Societatis Entomologicae Rossicae 1: 79-86, pl. II.
- Radoszkowski, O. 1887. Hyménoptères de Koree. Horae Societatis Entomologicae Rossicae 21: 428-436.
- Saussure, H. de. 1858. Note sur la famille des Vespides. Revue et magasin de zoologie 2(10): 259-261.
- Schilling, P.S. 1850. Die in Schlesien und der Graftschaft Glatz gesammelten Arten der Gattung *Vespa*. Jahresbericht der Schlesischen Gesellschaft für Vaterländische Cultur 1850(1): 76-78.
- Schmiedeknecht, O. 1881. Über einige deutsche *Vespa*-Arten. Entomologische Nachrichten 7: 313-318.
- Schulz, W.A. 1906. Spolia Hymenopterologica. Insel Creta. 355 pp. Paderborn.
- Scopoli, G.A. 1763. *Entomologia Carniolica exhibens insecta Carnioliae indigena et distributa in ordines, genera, species, varietates*. Vienna: Johan Thomas von Trattner.
- Smith, F. 1843. Descriptions of the British wasps. Zoologist 1: 161-171.
- Smith, F. 1849. Descriptions of new species of British bees. Zoologist 7, App.: lvii-lx.
- Smith, F. 1873. Descriptions of aculeate Hymenoptera of Japan, collected by Mr. George Lewis at Nagasaki and Hiogo. Transactions of the Entomological Society of London 1873: 181-206.
- Sonan, J. 1929. On *Vespa* from Formosa. Transactions of the Natural History Society of Formosa 19: 136-149.
- Stolfa, E. 1932. Il genere *Vespa* nella Venezia Giulia. Memorie della Societa Entomologica Italiana 9(1): 24-29.
- Stolfa, D.E. 1934. Due nuovi Vespidi indiani. Bollettino del Museo civico di Storia Naturale di Venezia 1: 47-49.
- Takamizawa, K. 2005. Description of a New Species of *Vespula* (Subgenus *Vespula*) From Nagano Pref., Central Honshu, Japan (Hymenoptera: Vespidae): P. 148, (In: Takamizawa, K., Ed, *The Japanese Social Wasps and Bees*), The Shinano Manichi Shimban, Nagano.
- Thomson, C.G. 1869. Ofversigt of Sveriges Vespariae. Opuscula Entomologica 1: 78-82.
- Williams, P.H. 1988. Social wasps (Hym., Vespidae) from the Kashmir Himalaya. Entomologist's Monthly Magazine 124: 149-152.

A new species of the genus *Pediobius* Walker (Eulophidae: Entedoninae) parasitizing spider from India

*Mohd Majid Jamali¹, Shahid Bin Zeya¹ & Kamalanathan Veenakumari²

¹Department of Zoology, Aligarh Muslim University, Aligarh 202 002, Uttar Pradesh, India.

²National Bureau of Agricultural Insect Resources, P.B. No. 2491, Hebbal, Bengaluru, India 560024.

(Email: majidjamali1988@gmail.com)

Abstract

A new species of the subfamily Entedoninae viz. *Pediobius hebbalensis* sp. n. is described from Karnataka state of India. It was reared from the egg sacs of spider. The new species is also compared with another spider parasitizing species of genus *Pediobius* Walker.

Keywords: *Parasitoids, new species, Bengaluru.*

Received: 27 July 2017; Revised: 2 June 2018; Online: 4 June 2018.

Introduction

Pediobius Walker, 1846 is a cosmopolitan genus containing 26 species from India among 222 species known worldwide (Noyes, 2017). Members of the genus display a wide range of parasitism and are considered as either primary or secondary parasitoids of different insects groups such as Coleoptera, Dermaptera, Diptera, Hemiptera, Hymenoptera, Lepidoptera, Neuroptera, Orthoptera, Thysanoptera and very rarely on eggs of spiders (Kerrich 1973; Bouček, 1988; Hansson, 2013). The species *Pediobius grunini* (Nikolskaya), *P. brachycerus* (Thomson) (Fitton *et al.*, 1987), *P. imbreus* (Walker) (Khan and Shafee, 1982) and *P. pyrgo* (Walker) (Schoeninger *et al.*, 2015) have been recorded parasitizing eggs of spiders.

In the present paper we deal with the record and description of a new species *Pediobius hebbalensis* sp. n. parasitizing the egg sac of an unidentified spider. The host spider is an unknown species with an egg (Fig. 3) of about 0.59-0.64 mm in diameter.

Materials and Methods

Specimens were reared from egg sacs (Fig. 1) of unknown spider from Hebbal near Bengaluru, Karnataka. Adult female and male specimens were found on the egg sac (Fig. 2). Six adults were separated from egg sac and

mounted on cards. Body colour was noted from card mounted specimens before clearing and mounting the three specimens (2 females, 1 male) on slides in Canada balsam. Body length for the new species is given in millimetres (mm). All other measurements are relative taken from the divisions of a linear scale of a micrometer placed in the eye piece of a compound microscope. These measurements were taken at 100× magnification of the microscope.

The photographs of card mounted specimens are taken with digital camera (Nikon DS-Fi2) attached to a stereo zoom Nikon SMZ25 and the photographs of slide mounted parts were taken with a digital camera (Nikon DS-Fi1c) attached to a compound microscope (Nikon Eclipse Ci). The following abbreviations are used in the text:

C1, C2 etc. = Clavomeres 1, 2 etc.

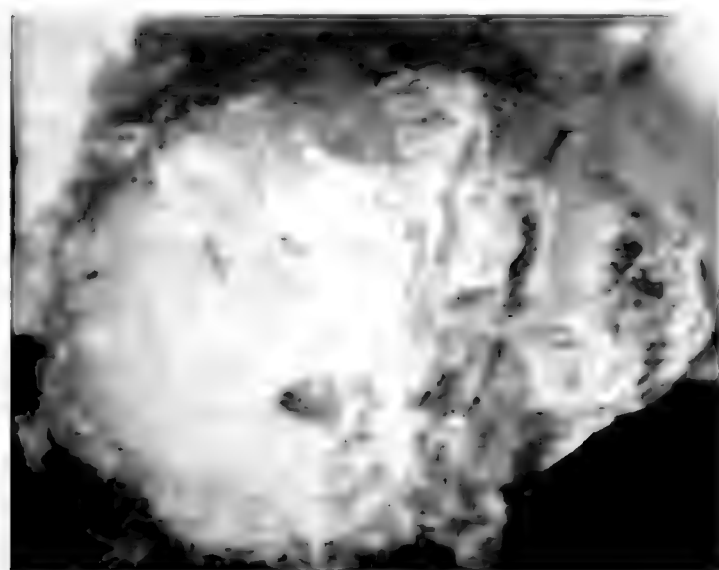
F1, F2, etc. = Funicular segments 1, 2 etc.

T1, T2, etc. = Gastral tergites 1, 2 etc.

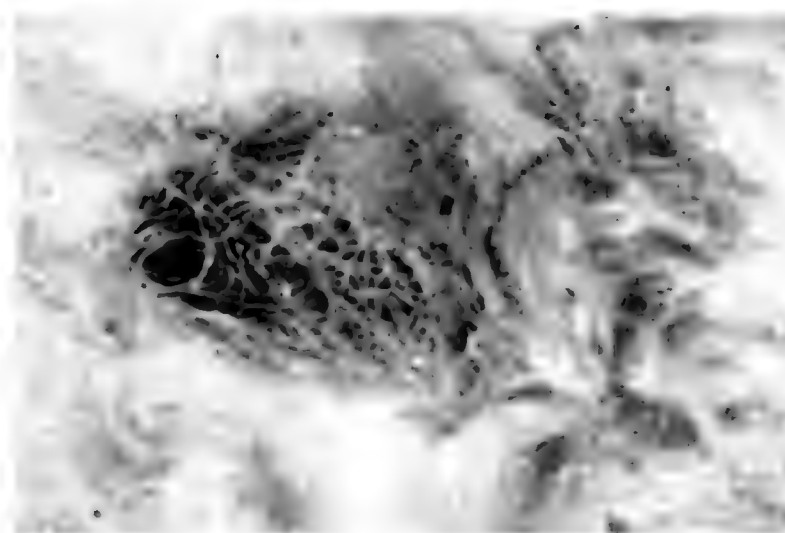
Genus *Pediobius* Walker, 1846

Diagnosis: Hansson (2002) should be consulted for a generic diagnosis.

Distribution: Worldwide.



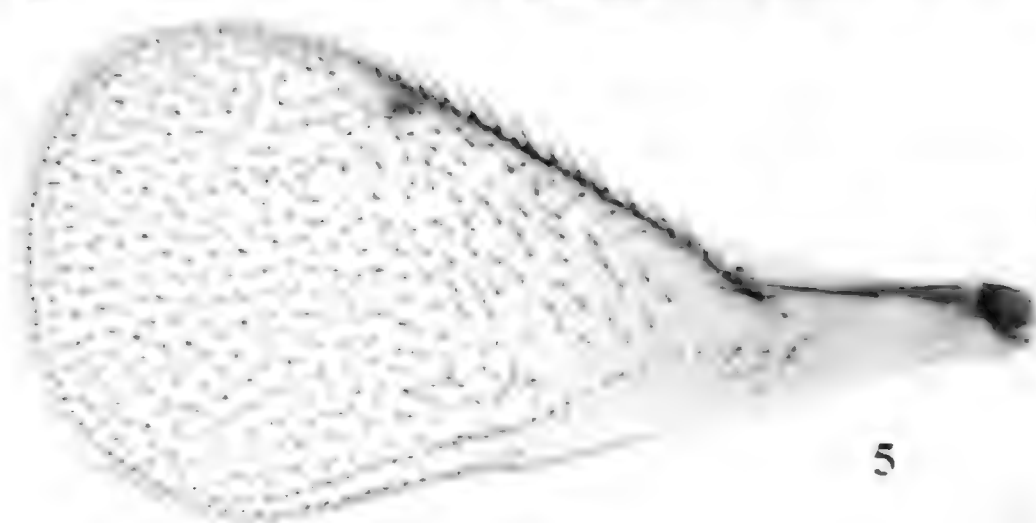
1



2



4



5

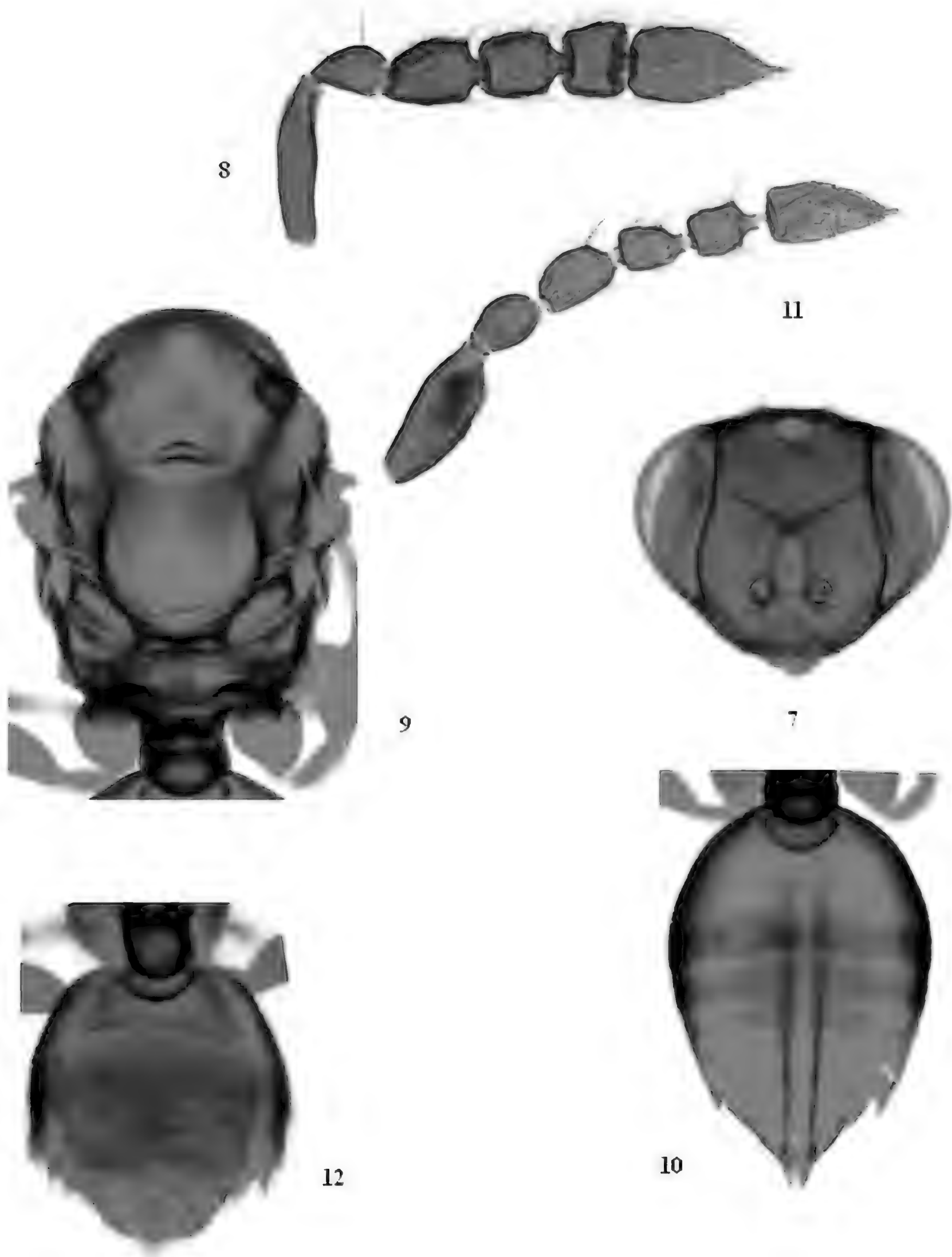


6



3

Figures 1–6. 1, egg sac of spider; 2, specimen within egg sac; 3, spider egg. (4–6) *Pediohius hebbalensis* sp. n. female: 4, habitus image; 5, fore wing; 6, hind wing



Figures 7-12. *Pediobius hebbalensis* sp. n. female: 7, Head frontal view; 8, antenna; 9, mesosoma; 10, metasoma. (11 & 12) male: 11, antenna; 12, metasoma.

Pediobius hebbalensis Jamali, Zeya &
Veenakumari sp. n.
(Figures 4–12)

[urn:lsid:zoobank.org:act:80183969-873D-4535-B558-FFD72B522623](https://zoobank.org/urn:lsid:zoobank.org:act:80183969-873D-4535-B558-FFD72B522623)

Description:

Female (Fig. 4): Length 1–1.25 mm (Holotype, 1.04). Head metallic dark brown. Antenna brown to dark brown. Mesosoma metallic dark brown to black. Fore wing (Fig. 2) hyaline. All legs brown except

first three tarsomeres pale white. Gaster metallic brown to dark brown.

Head (Fig. 7): Head broader than mesosoma, in frontal view, 1.29× as broad as long, 1.64× frontovertex width; vertex with long setae between POL and OOL; frontal suture reaching upto middle of eye; eye height 3.06× as long as malar space; Antennal toruli situated at the level of lower eye margin. Antennal (Fig. 8) scape with some scattered setae, 4.8× as long as broad and 2.6× pedicel length; pedicel 1.28× as long as broad; flagellum with single annulus; funicle 3-segmented, F1 invariably longer than F2 and F3 individually; clava 2-segmented, 1.75× as long as broad, first clavomere longer than second and second clavomere conical with an apical spicula.

Mesosoma (Fig. 9): Mesosoma 1.42× as long as broad; pronotum almost smooth with 4 long setae at posterior margin; mesoscutum with polygonal reticulation; notauli distinct anteriorly reaching up to one-third length of mesoscutum; mid lobe of mesoscutum with 2-pairs of setae; axillae faintly reticulate; scutellum slightly longer than broad, with longitudinal reticulation and 1-pair of setae latero-submedially; dorsellum narrow and smooth; propodeum smooth with two submedian carinae, diverging posteriorly. Fore wing (Fig. 5) 1.95× as long as broad; marginal vein + parastigma 1.8× submarginal vein length and 17.5× as long as stigmal vein; post marginal vein 2× as long as stigmal vein; longest marginal seta 0.073× maximum wing width. Hind wing (Fig. 6) 4.6× as long as broad; longest marginal seta 0.31× maximum wing width.

Metasoma (Fig. 10): Petiole 1.7× as broad as long with polygonal reticulation; gaster shorter than mesosoma; ovipositor covering whole length of gaster, slightly exerted beyond apex of gaster; ovipositor 2.5× as long as hind tibia.

Relative measurements (holotype): Head height: width, 40: 31; eye height, 23; malar space, 7.5; antennal segments length: width – scape, 12: 2.75; pedicel: 4.5: 3.5; F1, 5.75: 4.75; F2, 5.25: 4.75; F3, 3.5: 5.5; C1, 6.25: 5.5, C2, 3.25: 3.5; spicula, 1.5. Mesosoma length: width (dorsal view), 47: 33; fore wing length: width, 80: 41; longest marginal seta, 3; submarginal vein length, 19; parastigma length, 4; marginal vein length, 31; stigmal vein length, 2; postmarginal vein length, 4. Hind wing length: width, 68: 14.5;

longest marginal seta, 4.5; hind tibia, 20; width between carinae anteriorly: posteriorly, 1.75: 4. Petiole length: width, 5: 8.5; gaster length, 40; ovipositor length, 50.

Male: Similar to female except sexual dimorphism. Antenna (Fig. 11) with short and broad scape, about 2.23× as long as broad; gaster (Fig. 12) short and T1 reaching more than two-third of gaster.

Relative measurements: Antennal segments length: width – scape, 9.5: 4.25; pedicel: 3: 3.25; F1, 5: 3.5; F2, 4: 3; F3, 4.25: 3.25; C1, 4: 3.75, C2, 3.25: 3; spicula, 1.

Material examined: Holotype: female (on slide under four cover slip, slide No. EUL.183), labelled “INDIA: KARNATAKA, Bengaluru, Hebbal, 10.ix.2009, Coll. K. Veenakumari” (NBAIR, registration No. ICAR/NBAIR/EULP.103).

Paratype: 1 female (on slide, slide No. EUL.220), 3 females (on cards), 1male (on slide, slide No. EUL.221), 1males (on cards), some specimens inside spider cocoon with same data as for holotype. (3 females, 1 male, in ZDAMU; registration No. HYM.CH.775; 1 female, 1 male in NBAIR, registration No. ICAR/NBAIR/EULP.104, 105).

Biology: Egg parasitoid of an unknown species of spider.

Distribution: India: Karnataka.

Etymology: The name of species is derived from the name of the type locality.

Comments: The new species *Pediobius hebbalensis* sp. n. closely resembles to *P. pyrgo*, which also targets eggs of spiders. But it differs by the following characters: submedian carinae on propodeum slightly diverge posteriorly; fore wing speculum hairy except at very base; postmarginal vein long. Male antennal scape short and broad. Whereas in *P. pyrgo* sub-median carinae widely diverge posteriorly; fore wing speculum is completely bare; postmarginal vein short. Male antennal scape almost similar to female.

Acknowledgements

We thank the Chairman, Department of Zoology, Aligarh Muslim University, Aligarh, for providing research facilities. We are grateful to Science and Engineering Research Board, Department of Science &

Technology (SERB-DST), New Delhi for funding the research project on Parasitic Hymenoptera. Thanks are due to Dr. Mohammad Hayat the Principal Investigator of the ICAR “Network Project on Insect Biosystematics” AMU Centre, Department of Zoology, Aligarh Muslim University, Aligarh, for help and encouragement. We are also highly thankful to Christer Hansson for the valuable comments and suggestions which greatly improved the manuscript.

References

- Ambroziak, A.K. & Wawer, W. 2015. *Pediobius brachycerus* (Thomson, 1878) (Hymenoptera: Eulophidae): A Re-discovered Parasitoid in the Polish Fauna with a New Host Record. *Journal of Entomological Research Society* 17(3): 1-7.
- Boucek, Z., 1988. Australasian Chalcidoidea (Hymenoptera): A Biosystematic Revision of Genera of Fourteen Families, with a Reclassification of species. Wallingford, Oxon, U.K.: CAB International, 108 pp.
- Fitton, M.G., Shaw, M.R. & Austin, A.D. 1987. The Hymenoptera associated with spiders in Europe. *Zoological Journal of the Linnean Society* 90: 65-93.
- Hansson, C. 2002. Eulophidae of Costa Rica, 1. *Memoirs of the American Entomological Institute* 67: 1–290.
- Hansson, C. 2013. Neotropical Eulophidae. Available from: Available in: <http://www.neotropicaleulophidae.com> [Accessed: 27.06.2017].
- Kerrich, G.J. 1973. A revision of tropical and subtropical species of the Eulophid genus *Pediobius* Walker (Hymenoptera: Chalcidoidea). *Bulletin of the British Museum (Natural History)* 29: 115–199.
- Khan, M.Y. & Shafee, S.A. 1982. Species of the genus *Pediobius* Walker (Eulophidae: Entedoninae) from India. *Journal of the Bombay Natural History Society* 79: 370-374.
- Noyes, J.S. 2017. Universal Chalcidoidea Database. World Wide electronic publication. Available in: <http://www.nhm.ac.uk/chalcidoids>. [Accessed: 05.07.2017].
- Schoeninger, K., de Pádua, D.G., Salvatierra, L. & de Oliveira, M.L. 2015. First Record of *Pediobius pyrgo* (Walker)

- (Hymenoptera: Eulophidae) in South America and its Emergence from Egg Sacs of *Latrodectus geometricus* C. L. Koch (Araneae: Theridiidae). *EntomoBrasilis* 8(1): 79-81.
- Walker, F. 1839. *Monographia Chalciditum*. Vol. 1. London: Hyppolitus Baillière, 333 pp.
- Walker, F. 1846. Characters of some undescribed species of Chalcidites. (Continued). *Annals and Magazine of Natural History* 17: 177–185.

Collembola of India- An Updated Checklist

Guru Pada Mandal

Zoological Survey of India, M Block, New Alipore, Kolkata-700053.

(Email: gpmandal.zsi@gmail.com)

Abstract

An updated checklist of Collembola from India is provided with their distribution. A total of 342 species under 113 genera grouped in 20 families are listed. 307 species belong to 97 genera of order Poduromorpha + Entomobryomorpha and 35 species belongs to 16 genera of order Symphypleona. Additionally, a new distributional data have been provided for Seventy eight species recorded from different states of India.

Keywords: *Collembola, species, checklist, India.*

Received: 9 May 2017; Revised: 3 June 2018; Online: 5 June 2018.

Introduction

The Collembola, commonly called “spring-tails”, are small, entognathous, wingless hexapods possessing a spring-like forked jumping organ, the furcula, underneath the fourth abdominal segment. There are about 8800 described species of Collembola worldwide (Bellinger *et al.*, 2018).

The first Indian species of collembola from Malabar hill regions was published by Ritter (1910). Thereafter, Imms (1912), Carpenter (1917, 1924), Handschin (1925, 1929), Bonet (1930), Brown (1932), Mukherjee (1932), Denis, (1936, 1947), Baijal (1955a, b, 1956; 1958, 1971a, b), Baijal and Verma (1986), Paliwal and Baijal (1985), Tyagi and Baijal (1978, 1982), Salmon (1956a, b, 1957a, b, 1958, 1963, 1965, 1969, 1970), Arora and Singh (1962), Choudhuri and Roy (1965), Yosii (1966a, b), Prabhoo (1970, 1971a, b, c) Prabhoo and Muraleedharan (1980), Cassaganu (1980, 1988, 1990), Mitra (1966a, b, 1967, 1973a, b, 1974a, b, 1975, 1976a, b), Hazra *et al.* (2003, 2004, 2006a, b, 2007), Hazra and Mandal (2007, 2010, 2012), Mandal (2011, 2013, 2014, 2018), Mandal and Hazra (2004, 2005, 2009), Mandal and Suman (2013a, b, 2014, 2015, 2016, 2017) contributed to the knowledge of Indian Collembola. Recently, Baquero, Mandal and Jordana (2014, 2015), Hazra and Mandal (2015), Mandal, Suman and Bhattacharya (2016, 2017)

are some of the researchers who have substantially added a number of species to the Collembola from India. Indian fauna of Collembola is represented by 342 species of 113 genera belonging to 20 families. Out of which, Poduromorpha + Entomobryomorpha consists of 307 species in 97 genera in 12 families: Neanuridae (55 species of 24 genera), Tullbergidae (6 species of 3 genera), Brachystomellidae (3 species of one genus), Hypogastruridae (23 species of 5 genera), Onychiuridae (5 species of 4 genera), Oncopoduridae (one species of one genus), Odontellidae (3 species of 2 genera), Isotomidae (42 species of 20 genera), Orchesellidae (12 species of 4 genera), Entomobryidae (83 species of 17 genera), Paronellidae (69 species of 15 genera), Tomoceridae (5 species of one genus) and Symphylopleona consists of 35 species in 16 genera in 8 families: Neelidae (one species of one genus), Sminthuridae (12 species of 5 genera), Katiannidae (one species of one genus), Dicyrtomidae (5 species of 2 genera), Collophoridae (2 species of one genus), Bourletiellidae (4 species of 2 genera), Sminthurididae (8 species of 3 genera) and Arrhopalitidae (one species of one genus). The objective of this paper is to provide up to date list on Collembola fauna of India with distribution records.

The Checklist

Detail synonymies for the names listed here are available on the website (www.collembola.org). Distribution records of species are based on published work of previous authors and recent publication of the author. The symbol (*) indicates new distributional record from different states of India for the species.

Class Collembola Lubbock, 1870

Order Poduromorpha Börner, 1913, sensu

D'Haese, 2002

Superfamily Neanuroidea Massoud, 1967

Family Neanuridae Börner, 1901 sensu Yosii, 1956

Subfamily Frieseinae Massoud, 1967

Genus *Friesea* Von Dalla Torre, 1895

Friesea excelsa Denis, 1936

Distribution: India (Jammu and Kashmir, Kerala, West Bengal).

Friesea maxima Baijal, 1956

Distribution: India (Himachal Pradesh).

Friesea yosii, Prabhoo, 1971

Distribution: India (Kerala).

Subfamily Neanurinae Börner, 1901, Sensu

Cassagnau, 1989

Tribe Lobellini Cassagnau, 1983

Genus *Adbiloba* Stach, 1951

Adbiloba sikkimensis (Yosii, 1966)

Distribution: India (Sikkim).

Genus *Blasconura* Cassagnau, 1983

Blasconura toda Cassagnau, 1988

Distribution: India (Nilgiri, Tamil Nadu).

Blasconura palniensis Cassagnau, 1988

Distribution: India (Palni, Tamil Nadu).

Blasconura prabhooi Cassagnau, 1988

Distribution: India (Nilgiri, Tamil Nadu).

Blasconura sholica Cassagnau, 1988

Distribution: India (Nilgiri, Tamil Nadu).

Blasconura anamalaisensis Cassagnau, 1988

Distribution: India (Anamalai, Tamil Nadu).

Genus *Calvinura* Cassagnau, 1988

Calvinura reducta Cassagnau, 1988

Distribution: India (Anamalai, Tamil Nadu).

Genus *Gnatholonche* Börner, 1906

Gnatholonche intermedia (Imms, 1912) Stach, 1951

Distribution: India (Naini Tal, Uttarakhand).

Gnatholonche polychaetosa Cassagnau, 1984

Distribution: India (Darjeling, West Bengal).

Genus *Himalmeria* Cassagnau, 1984

Himalmeria ornata Cassagnau, 1984

Distribution: India (Darjeling, West Bengal).

Himalmeria karmapa Cassagnau, 1984

Distribution: India (Sikkim).

Subgenus *Yetimeria* Cassagnau, 1984

Himalmeria (Y.) *sikkimensis* Cassagnau, 1984

Distribution: India (Sikkim).

Himalmeria (Y.) *lama* Cassagnau, 1984

Distribution: India (Darjeling, West Bengal).

Himalmeria (Y.) *rostrata* Cassagnau, 1984

Distribution: India (Darjeling, West Bengal).

Himalmeria (Y.) *armata* Cassagnau, 1984

Distribution: India (Sukna, West Bengal).

Himalmeria (Y.) *lanata* Cassagnau, 1984

Distribution: India (Singhlila National Park, Darjeling, West Bengal).

Himalmeria (Y.) *spatulata* Cassagnau, 1984

Distribution: India (Singhlila National Park, Darjeling, West Bengal).

Genus *Hyperlobella* Cassagnau, 1988

Hyperlobella kraepelini (Börner, C., 1906)

Cassagnau, P., 1988

Distribution: India (Kerala, Arunachal Pradesh*, Uttarakhand*, Maharashtra, Mizoram*).

Genus *Inameria* Cassagnau, 1983

Inameria corallina (Imms, 1912) Cassagnau, 1983

Distribution: India (Kerala).

Genus *Lobella* Börner, C., 1906

Subgenus *Protolobella* Cassagnau, 1983

Lobella (P.) *assamensis* Yosii, 1966

Distribution: India (Assam, Mizoram*).

Subgenus *Lobella* Cassagnau, 1983

Lobella (L.) *malabarica* Yosii, 1966

Distribution: India (Maharashtra).

Lobella (L.) *maxillaris* Yosii, 1966

Distribution: India (Botanic Garden, West Bengal).

Genus *Neanura* MacGillivray, 1893

Neanura muscorum (Templeton, 1836) Cart, 1899

Distribution: India (Kerala).

Genus *Nilgirella* Cassagnau, 1983

Nilgirella indica (Handschin, 1929) Cassagnau, 1983

Distribution: India (Nilgiri, Tamil Nadu).

Nilgirella longiseta Cassagnau, 1988

Distribution: India (Nilgiri, Tamil Nadu).

Nilgirella palniensis Cassagnau, 1988

Distribution: India (Palni, Tamil Nadu).

Nilgirella piljainae Cassagnau, 1988

Distribution: India (Nilgiri, Tamil Nadu).

Tribe Paleonurini Cassagnau, P., 1989

Genus *Paleonura* Cassagnau, P., 1982

Paleonura lonavlana (Yosii, 1966) Cassagnau, 1982

Distribution: India (Maharashtra).

Paleonura siva (Yosii, 1966) Cassagnau, 1982

Distribution: India (Botanic Garden, West Bengal)

Paleonura macronychia Cassagnau, 1988

Distribution: India (Kerala).

Paleonura badaga Cassagnau, 1988

Distribution: India (Nilgiri, Tamil Nadu).

Paleonura barbata Cassagnau, 1988

Distribution: India (Palni, Tamil Nadu).

Paleonura decorata Cassagnau, 1988

Distribution: India (Kerala).

Genus *Paranura* Axelson, 1902

Paranura tamul Cassagnau, P., 1983

Distribution: India (Palni, Tamil Nadu).

Paranura garoensis Cassagnau, 1991

Distribution: India (Meghalaya).

Paranura coenobita Cassagnau, 1991

Distribution: India (Sikkim).

Paranura squamosa Cassagnau, 1991

Distribution: India (Darjeling, West Bengal).

Genus *Parvatinura* Cassagnau, 1984

Parvatinura loebli Cassagnau, 1984

Distribution: India (Darjeling, West Bengal).

Parvatinura colcheni Cassagnau, 1984

Distribution: India (Darjeling, West Bengal).

Genus *Pronura* Delamare Deboutteville, 1953

Pronura indiana Salmon, 1969

Distribution: India (Sikkim, Assam, Uttar Pradesh*).

Genus *Protanura* Börner, 1900

Protanura carpenteri Mukherjee, 1932

Distribution: India (West Bengal).

Genus *Singalimeria* Cassagnau, 1984

Singalimeria pachyderma Cassagnau, P., 1984

Distribution: India (Singhlila National Park, Darjeling, West Bengal).

Genus *Tamulmeria* Cassagnau, 1988

Tamulmeria callipygos Cassagnau, 1988

Distribution: India (Ootacamund, Tamil Nadu).

Tamulmeria keralensis Cassagnau, 1988

Distribution: India (Kerala).

Genus *Womersleya* Denis, 1948

Womersleya marhia Baijal, 1958

Distribution: India (Himachal Pradesh).

Subfamily Pseudochorutinae Börner, 1906

Genus *Cephalochorutes* Bedos and Deharverg, 1991

Cephalochorutes pillaii (Prabhoo, 1971) Bedos and Deharverg, 1991

Distribution: India (Kerala).

Genus *Ceratrimeria* Börner, C., 1906

Ceratrimeria indica (Handschin, 1929) Massoud, 1967

Distribution: India (Nilgiri, Tamil Nadu).

Genus *Oudemansia* Schott, 1893

Oudemansia coerulea Schött, 1893

Distribution: India (Kanyakumari, Tamil Nadu).

Genus *Pseudachorutes* Tullberg, 1871

Pseudachorutes anomalus Imms, 1912

Distribution: India (Kurseong, West Bengal).

Pseudachorutes periyarensis Prabhoo, 1971

Distribution: India (Kerala).

Pseudachorutes ponmudiensis (Prabhoo, 1971)

Distribution: India (Kerala).

Subfamily Uchidanurinae Salmon, 1964

Genus *Assamanura* Cassagnau, 1980

Assamanura besucheti Cassagnau, 1980

Distribution: India (Khasi Hills, Meghalaya).

Family Brachystomellidae Stach, 1949

Genus *Brachystomella* Agren, 1903

Brachystomella contorta Denis, 1931

Distribution: India (Kerala).

Brachystomella surendrai Goto, 1961

Distribution: India (Rajasthan).

Brachystomella terrafolia Salmon, 1944

Distribution: India (Kerala, Maharashtra)

Family Tullberg*ii*dae Bagnall, 1935

Genus *Mesaphorura* Börner, 1901

Mesaphorura choudhuriai Yosii, 1966

Distribution: India (Sikkim, Maharashtra).

Mesaphorura intermedia Prabhoo, 1971

Distribution: India (Kerala).

Genus *Paratullbergia* Womersley, 1930

Paratullbergia indica Salmon, 1965

Distribution: India (Kerala).

Paratullbergia salmoni Prabhoo, 1971

Distribution: India (Kerala).

Paratullbergia trivandranana Prabhoo, 1971

Distribution: India (Kerala).

Genus *Prabhergia* Salmon, 1965

Prabhergia nayarii Salmon, 1965

Distribution: India (Kerala).

Superfamily Hypogastruroidea Salmon, 1964

Family Hypogastruridae Börner, 1906

Genus *Acherontiella* Absolon, 1913

Acherontiella bougisi Cassagnau and Delamare, 1955

Distribution: India (Kerala).

Genus *Ceratophysella* Börner in Brohmer, 1932

Ceratophysella indica (Salmon, 1956)

Distribution: India (Sikkim, West Bengal*).

Ceratophysella indovaria (Salmon, 1970)

Distribution: India (Sikkim, Arunachal Pradesh, Assam, Manipur, Mizoram, Maharashtra, Rajasthan, West Bengal*, Andhra Pradesh*, Uttar Pradesh*, Uttarakhand*, Himachal Pradesh *, Jharkhand*, Andaman and Nicobar Islands*).

Ceratophysella communis (Folsom, 1897)

Distribution: India (Jammu and Kashmir, Himachal Pradesh*, Uttar Pradesh*).

Ceratophysella armata (Nicolet, 1842) Börner, 1932

Distribution: India (Jammu and Kashmir).

Ceratophysella narkandae (Baijal, 1955)

Distribution: India (Himachal Pradesh).

Genus *Hypogastrura* Bourlet, 1839

Subgenus *Hypogastrura* Bourlet, 1839

Hypogastrura baltica Tyagi and Baijal, 1982

Distribution: India (Bijnor, Uttar Pradesh).

Hypogastrura katraensis Tyagi and Baijal, 1982

Distribution: India (Himachal Pradesh).

Collembola of India- An Updated Checklist

Hypogastrura prabhoi Bhattacharjee, 1985

Distribution: India (Meghalaya).

Hypogastrura sonapani Baijal, H.N., 1958

Distribution: India (Himachal Pradesh).

Hypogastrura temarpurensis Tyagi and Baijal, 1982

Distribution: India (Bijnor, Uttar Pradesh).

Hypogastrura unguiculata Mitra, 1966

Distribution: India (Uttarakhand).

Hypogastrura manubrialis (Tullberg, 1869)

Linnaniemi, 1912

Distribution: India (Jammu and Kashmir).

Hypogastrura rangkuli Martynova, 1975

Distribution: India (Ladak).

Hypogastrura nivicola (Fitch, 1847) Yosii, 1960

Distribution: India (Jammu and Kashmir).

Hypogastrura consanguinea (Folsom, 1924)

Handschin, 1928

Distribution: India (Tamil Nadu).

Genus *Willemia* Börner, 1901

Willemia delamarei Prabhoo, 1971

Distribution: India (Kerala).

Willemia setonychia Prabhoo, 1971

Distribution: India (Kerala).

Genus *Xenylla* Tullberg, 1869

Xenylla hadialii Baijal, 1955

Distribution: India (Himachal Pradesh).

Xenylla obscura Imms, 1912

Distribution: India (Sikkim, Manipur, Arunachal Pradesh, Mizoram, Nagaland, Himachal Pradesh*, Maharashtra, Rajasthan, West Bengal*, Uttar Pradesh*, Uttarakhand*, Andhra Pradesh*, Andaman and Nicobar Islands*).

Xenylla reducta Prabhoo, 1971

Distribution: India (Kerala).

Xenylla sincta Baijal, 1956

Distribution: India (Himachal Pradesh, Jammu and Kashmir*).

Xenylla welchi Folsom, 1916

Distribution: India (Kerala).

Superfamily Onychiuroidea sensu D'Haese, 2002

Family Onychiuridae Börner, 1901

Genus *Allonychiurus* Yoshii, 1995

Allonychiurus indicus (Choudhuri and Roy, 1965)

Pomorski, 2002

Distribution: India (West Bengal, Maharashtra*).

Genus *Onychiurus* Gervais, 1841

Onychiurus bhatti Yosii, 1963

Distribution: India (Himachal Pradesh).

Genus *Protaphorura* Absolon, 1901

Protaphorura kultia (Baijal, 1956) Salmon, 1964

Distribution: India (Himachal Pradesh).

Tribe Thalassaphorurini Pomorski, 1998

Genus *Thalassaphorura* Bagnall, 1949

Thalassaphorura clayae (Salmon, 1958) Pomorski, 2002

Distribution: India (Sikkim).

Thalassaphorura ghatensis (Prabhoo, 1971)

Pomorski, 2002

Distribution: India (Kerala).

Family Odontellidae Massoud, 1967

Genus *Spinanurida* Salmon, 1969

Spinanurida mandibulata Salmon, 1969

Distribution: India (Sikkim).

Genus *Superodontella* Stach, 1949

Superodontella altitudina (Salmon, 1969)

Distribution: India (Sikkim).

Superodontella macronychia (Prabhoo, 1971)

Distribution: India (Kerala).

Order Entomobryomorpha Börner, 1913, sensu Soto-Adames *et al.*, 2008

Superfamily Tomoceroidea Szeptycki, 1979

Family Oncopoduridae Carl and Lebedinsky, 1905

Genus *Oncopodura* Carl and Lebedinsky, 1905

Oncopodura indica Yosii, 1966

Distribution: India (Maharashtra).

Family Tomoceridae Schaffer, 1896

Subfamily Tomecerinae Schaffer, 1896

Genus *Tomocerus* Nicolet, (1842)

Tomocerus mitrai Prabhoo and Muraleedharan, 1980

Distribution: India (Himachal Pradesh, Arunachal Pradesh*, Uttarakhand*, Jammu and Kashmir*, Sikkim*).

Tomocerus petalospinus Salmon, 1969

Distribution: India (Sikkim, Jammu and Kashmir*).

Tomocerus serratospinus Salmon, 1941

Distribution: India (Sikkim).

Tomocerus vulgaris (Tullberg, 1871) Brook, 1883

Distribution: India (Jammu and Kashmir).

Tomocerus ashoka Yosii and Ashraf, 1965

Distribution: India (Jammu and Kashmir).

Superfamily Isotomoidea Szeptycki, 1979

Family Isotomidae Schaffer, 1896

Subfamily Anurophorinae Börner, 1901

Genus *Cryptopygus* Willem, 1901

Cryptopygus indicus Brown, 1932

Distribution: India (Tamil Nadu).

Cryptopygus tridentus (Handschin, 1929)

Distribution: India (Tamil Nadu).

Genus *Hemisotoma* Bagnall, 1949

Hemisotoma thermophila (Axelson, 1900) Bagnall, 1949

Distribution: India (Maharashtra, Kerala, West Bengal, Manipur, Assam, Odisha, Rajasthan, Sikkim*, Arunachal Pradesh*).

Genus *Isotomodes* Axelson, 1907

Isotomodes dagamae Prabhoo, 1971

Guru Pada Mandal

Distribution: India (Kerala, West Bengal, Maharashtra, Rajasthan, Uttar Pradesh).

Genus *Rhodanella* Salmon, 1945

Rhodanella fasciata (Carpenter, 1912)

Distribution: India (Uttar Pradesh, Manipur, Sikkim).

Subfamily Isotominae Schaffer, 1896

Genus *Aackia* Yosii, 1966

Aackia karakoramensis Yosii, 1966

Distribution: India (Jammu and Kashmir).

Genus *Axelsonia* Börner, 1906

Axelsonia nitida (Folsom, 1899) Börner, 1906

Distribution: India (Maharashtra, West Bengal*, Odisha*).

Genus *Desoria* Agassiz and Nicolet, 1841

Desoria mazda Yosii, 1971

Distribution: India (Sikkim, Jammu and Kashmir*).

Desoria trispinata (Mac Gillivray, 1896) Mendoza Arviso, 1999

Distribution: India (Sikkim, Assam*, Nagaland*).

Desoria jayasrae Bhattacharjee, 1985

Distribution: India (Meghalaya, Assam).

Genus *Isotoma* Bourlet, 1839

Isotoma fasciata Börner, 1909

Distribution: India (Maharashtra).

Isotoma himalayana (Baijal, 1955)

Distribution: India (Himachal Pradesh, Jammu and Kashmir).

Isotoma sarkundensis Baijal, 1958

Distribution: India (Himachal Pradesh, Jammu and Kashmir).

Isotoma spinicauda Bonet, 1930

Distribution: India (Ladak, Jammu and Kashmir).

Isotoma plumosa (Salmon, 1969)

Distribution: India (Sikkim).

Genus *Isotomiella* Bagnall, 1939

Isotomiella minor (Schaeffer, 1896) Yosii, 1939

Distribution: India (Kerala, West Bengal, Odisha, Maharashtra, Arunachal Pradesh*, Rajasthan, Manipur*, Tripura*, Sikkim).

Genus *Isotomurus* Börner, 1903

Isotomurus balteatus (Reuter, 1876) Handschin, 1929

Distribution: India (Kerala, West Bengal, Odisha, Maharashtra*, Arunachal Pradesh *, Manipur*, Tripura*, Andhra Pradesh*, Uttarakhand*, Jharkhand*, Andaman and Nicobar Islands*).

Isotomurus ciliatus Stach, 1947

Distribution: India (West Bengal, Odisha, Maharashtra*).

Isotomurus palustris (Muller, 1776) Börner, 1906

Distribution: India (West Bengal, Odisha, Maharashtra*).

Isotomurus jharkhandensis Mandal, Suman and Bhattacharya, 2017

Distribution: India (Jharkhand).

Isotomurus dhanbadensis Mandal, Suman and Bhattacharya, 2017

Distribution: India (Jharkhand).

Isotomurus indicus Mandal, Suman and Bhattacharya, 2017

Distribution: India (Jharkhand).

Isotomurus sahebganjensis Mandal, Suman and Bhattacharya, 2017

Distribution: India (Jharkhand).

Genus *Parisotoma* Bagnall, 1940

Parisotoma notabilis (Schaffer, 1896) Bagnall, 1940

Distribution: India (Sikkim).

Genus *Procerura* Salmon, 1941

Procerura indica (Baijal, 1958) Greenslade, 2003

Distribution: India (Himachal Pradesh, Jammu and Kashmir*).

Procerura transequatoria (Salmon, 1969) Greenslade, 2003

Distribution: India (Sikkim).

Subfamily Proisotominae Stach, 1947

Genus *Appendisotoma* Stach, 1947

Appendisotoma tridentata (Baijal, 1958) Potapov, 2001

Distribution: India (Himachal Pradesh).

Genus *Ballistura* Börner, 1906

Ballistura bengalensis Yosii, 1966

Distribution: India (West Bengal, Maharashtra, Kerala).

Ballistura fitchi (Denis, 1933)

Distribution: India (Nilgiri, Tamil Nadu).

Genus *Folsomia* Willem, 1902

Folsomia baijali Prabhoo, 1971

Distribution: India (Kerala).

Folsomia santokhi (Baijal, 1958)

Distribution: India (Himachal Pradesh).

Folsomia octoculata Handschin, 1925

Distribution: India (Nilgiri, Tamil Nadu).

Folsomia fimetaria (Linn.) Handschin, 1929

Distribution: India (Nilgiri, Tamil Nadu).

Folsomia candida Willem, 1902

Distribution: India (Meghalaya).

Genus *Folsomides* Stach, 1922

Folsomides parvulus Stach, 1922

Distribution: India (Kerala, Maharashtra, West Bengal).

Genus *Folsomina* Denis, 1931

Folsomina onychiurina Denis, 1931

Distribution: India (Kerala, Maharashtra, Uttar Pradesh*).

Genus *Isotopenola* Potapov, Babenko, Fjellberg, and Greenslade, 2009

Isotopenola nilgiris (Denis, 1947) Potapov, Babenko, Fjellberg and Greenslade, 2009

Distribution: India (Nilgiri, Tamil Nadu).

Genus *Proisotoma* Börner, 1901

Collembola of India- An Updated Checklist

Proisotoma himalayana Baijal, 1958

Distribution: India (Himachal Pradesh, Jammu and Kashmir, Uttar Pradesh*).

Proisotoma senetijohani Baijal and Chandra, 1970

Distribution: India (Uttar Pradesh).

Proisotoma minuta (Tullberg, 1871) Börner, 1903

Distribution: India (Kerala, Maharashtra).

Proisotoma pakurensis Mandal, Suman and Bhattacharya, 2017

Distribution: India (Jharkhand).

Genus *Scutisotoma* Bagnall, 1949

Scutisotoma ladaki (Denis, 1936) Potapov, Babenko, and Fjellberg, 2006

Distribution: India (Ladak, Jammu and Kashmir).

Superfamily Entomobryoidea Womersley, 1934, sensu Zhang *et al.*, 2015

Family Orchesellidae Börner, 1906

Subfamily Orchesellinae Börner, 1906

Genus *Orchesellides* Bonet, 1930

Orchesellides crassus (Imms, 1912)

Distribution: India (Uttarakhand, Uttar Pradesh*).

Orchesellides boraoi Bonet, 1930

Distribution: India (Jammu and Kashmir).

Subfamily Heteromurinae Absolon & Kseneman, 1942

Tribe Heteromururini Mari Mutt, 1980

Genus *Alloscopus* Börner, 1906

Alloscopus aspinosus Prabhaoo, 1971

Distribution: India (Kerala).

Alloscopus spinosus Prabhaoo, 1971

Distribution: India (Kerala).

Alloscopus tetracanthus (Börner, 1906)

Distribution: India (Kerala, West Bengal).

Genus *Dicranocentrus* Schött, 1893

Dicranocentrus indicus Bonet, 1930

Distribution: India (Maharashtra, West Bengal, Nagaland*, Manipur*, Mizoram*, Arunachal Pradesh*, Uttarakhand*, Uttar Pradesh*, Andaman and Nicobar Islands*).

Dicranocentrus cercifer (Imms, 1912) Mari Mutt, 1979

Distribution: India (West Bengal, Kerala, Jharkhand*)

Dicranocentrus singularis Mari Mutt and Bhattacharjee, 1980

Distribution: India (Meghalaya).

Dicranocentrus fraternus Mari Mutt and Bhattacharjee, 1980

Distribution: India (Meghalaya).

Dicranocentrus spinosus (Prabhaoo, 1971)

Distribution: India (Kerala).

Dicranocentrus stachi (Denis, 1925) Handschin, 1929

Distribution: India (Tamil Nadu).

Genus *Falcomurus* Mandal, 2018

Falcomurus chilikaensis Mandal, 2018

Distribution: India (Odisha).

Family Entomobryidae Schaffer, 1896

Subfamily Entomobryinae Schaffer, 1896

Genus *Entomobrya* Rondani, 1861

Entomobrya himalayensis (Baijal, 1955) Salmon, 1964

Distribution: India (Jammu and Kashmir, Himachal Pradesh).

Entomobrya indica (Baijal, 1955)

Distribution: India (Himachal Pradesh).

Entomobrya kultinalensis Baijal, 1958

Distribution: India (Himachal Pradesh).

Entomobrya logisticta Baijal, 1958

Distribution: India (Himachal Pradesh).

Entomobrya manii (Baijal, 1955) Salmon, 1964

Distribution: India (Himachal Pradesh).

Entomobrya nigrita (Baijal, H. N., 1958)

Distribution: India (Himachal Pradesh).

Entomobrya rohtangensis Baijal, 1958

Distribution: India (Himachal Pradesh).

Entomobrya nivalis (Linnaeus, 1758) Agren, 1904

Distribution: India (Himachal Pradesh, Jammu and Kashmir).

Entomobrya lampreyi (Salmon, 1957)

Distribution: India (Uttarakhand).

Entomobrya diskicensis Baquero, Mandal and Jordana, 2014

Distribution: India (Ladak, Jammu and Kashmir).

Entomobrya ladakhi Baquero, Mandal and Jordana, 2014

Distribution: India (Ladak, Jammu and Kashmir).

Entomobrya choudhuriai Baquero, Mandal and Jordana, 2014

Distribution: India (Ladak, Jammu and Kashmir).

Entomobrya mehtai Baquero, Mandal and Jordana, 2014

Distribution: India (Ladak, Jammu and Kashmir).

Entomobrya kajjaisensis Baquero, Mandal and Jordana, 2015

Distribution: India (Himachal Pradesh).

Entomobrya barogensis Baquero, Mandal and Jordana, 2015

Distribution: India (Himachal Pradesh).

Genus *Himalanura* Baijal, H.N., 1958

Himalanura indica Baijal, H.N., 1958

Distribution: India (Himachal Pradesh).

Himalanura baijalia Baquero, Mandal and Jordana, 2014

Distribution: India (Ladak, Jammu and Kashmir).

Himalanura chailensis Baquero, Mandal and Jordana, 2015

Distribution: India (Himachal Pradesh).

Himalanura himachalenis Baquero, Mandal and Jordana, 2015

Distribution: India (Himachal Pradesh).

Genus *Homidia* Börner, C., 1906

Homidia cingula (Börner, C., 1906) Yosii, 1959

Distribution: India (West Bengal, Maharashtra, Andhra Pradesh*, Himachal Pradesh*, Uttar Pradesh*, Uttarakhand*, Arunachal Pradesh*, Manipur*, Sikkim*, Mizoram*, Nagaland*, Odisha*).

Homidia lakhanpurensis Baquero, Mandal and Jordana, 2015

Distribution: India (Himachal Pradesh).

Tribe *Lepidocyrtini* Yoshii and Yanyu*k*, 1989

Genus *Lepidocyrtoides* Schött, 1917

Lepidocyrtoides quatuordecimocellata Prabhoo, 1971

Distribution: India (Kerala).

Genus *Mesentotoma* Salmon, 1942

Mesentotoma hutchinsoni (Denis, 1936) Jordana, 2012

Distribution: India (Ladak, Jammu and Kashmir).

Genus: *Pseudosinella* Schaeffer, 1897

Pseudosinella petterseni Börner, 1901

Distribution: India (Kerala, Maharashtra).

Genus *Sinella* Brook, 1882

Subgenus *Sinella* Brook, 1882

Sinella curviseta Brook, 1882

Distribution: India (Tamil Nadu, Himachal Pradesh, Uttar Pradesh*, Uttarakhand*, Jammu and Kashmir*, Arunachal Pradesh*, Assam*, Punjab*, Sikkim*, West Bengal, Andaman and Nicobar Islands*).

Sinella siva (Imms, 1912) Chen and Christiansan, 1993

Distribution: India (Uttarakhand).

Subgenus *Coecobrya* Yosii, 1956

Sinella (C.) *montana* Imms, 1912

Distribution: India (Uttarakhand).

Tribe *Willowsiini* Yoshii and Yayuk, 1989

Genus *Willowsia* Shoebottom, 1917

Willowsia nigromaculata (Lubbock, 1873), Salmon, 1945

Distribution: India (Sikkim, Himachal Pradesh*).

Willowsia brahma (Imms, 1912)

Distribution: India (Uttar Pradesh, Himachal Pradesh*).

Willowsia jacobsoni (Börner, 1913) Stach, 1965

Distribution: India (Himachal Pradesh, Jammu and Kashmir).

Willowsia kalatopensis Baquero, Mandal and Jordana, 2015

Distribution: India (Himachal Pradesh).

Subfamily *Lepidocyrtinae* Wahlgren, 1906 Ssensu Stach, 1955

Genus *Acanthurella* Börner, 1906

Acanthurella betlaensis Mandal, Suman and Bhattacharya, 2016

Distribution: India (Jharkhand).

Genus *Lepidocyrtus* Bourlet, 1839

Lepidocyrtus exploratorius Carpenter, 1924

Distribution: India (Meghalaya, Maharashtra, West Bengal*).

Subgenus *Acrocyrtus* Yosii, 1959

Lepidocyrtus (A.) *heterolepis* Yosii, 1959

Distribution: India (Maharashtra, Andhra Pradesh*, Arunachal Pradesh*, Manipur*, Uttar Pradesh*, Uttarakhand*, West Bengal*, Jharkhand*, Andaman and Nicobar Islands*).

Lepidocyrtus (A.) *malayanus* Yosii, 1959

Distribution: India (Maharashtra, Uttar Pradesh, Uttarakhand*, West Bengal* Mizoram, Arunachal Pradesh*, Manipur*, Nagaland*, Sikkim*, Tripura*, Andhra Pradesh*, Andaman and Nicobar Islands*).

Lepidocyrtus (A.) *cryptocephalus* Handschin, 1929

Distribution: India (Tamil Nadu).

Lepidocyrtus (A.) *cheni* Pan, Chatterjee, and Zhang, 2011

Distribution: India (Kerala).

Lepidocyrtus (A.) *himachalensis* Baquero, Mandal and Jordana, 2015

Distribution: India (Himachal Pradesh).

Subgenus *Allocyrtus* Yosii and Suhardjono, 1984

Lepidocyrtus (A.) *lepidornatus* (Handschin, 1930)

Distribution: India (Himachal Pradesh*).

Subgenus *Ascocyrtus* Yosii, 1963

Lepidocyrtus (A.) *magnificus* Carpenter, 1924

Distribution: India (Meghalaya, West Bengal, Arunachal Pradesh*, Manipur*, Mizoram*, Nagaland*, Sikkim*, Tripura*, Uttar Pradesh*, Uttarakhand*, Andaman and Nicobar Islands*).

Lepidocyrtus (A.) *scaber* Ritter, 1911

Distribution: India (Uttar Pradesh, West Bengal*).

Lepidocyrtus (A.) *suborientalis* Denis, 1948

Distribution: India (Himachal Pradesh).

Subgenus *Cinctocyrtus* Yoshi, and Yayuk, 1989

Lepidocyrtus (C.) *medius* Schaeffer, 1898

Distribution: India (West Bengal, Maharashtra, Rajasthan, Andhra Pradesh*, Manipur*, Mizoram*, Nagaland*, Sikkim*, Tripura*, Uttar Pradesh*).

Lepidocyrtus (C.) *kulluensis* Baquero, Mandal and Jordana, 2015

Distribution: India (Himachal Pradesh).

Subgenus *Lanocyrtus* Yoshii, and Yayuk, 1989

Lepidocyrtus (L.) *caeruleicornis* Bonet, 1930

Distribution: India (Maharashtra, West Bengal).

Lepidocyrtus (L.) *pallidus* Reuter, 1890

Distribution: India (Maharashtra).

Lepidocyrtus (L.) *cyaneus* Tullberg, 1871

Distribution: India (Uttar Pradesh, Uttarakhand*, Arunachal Pradesh*, Manipur*, Jharkhand*).

Collembola of India- An Updated Checklist

Lepidocyrtus (L.) *absens* Zhang, Chatterjee and Chen, 2009

Distribution: India (Andhra Pradesh).

Subgenus *Lepidocyrtus* Bourlet, 1839

Lepidocyrtus (L.) *agraensis* Baijal and Singha, 1971

Distribution: India (UttarPradesh).

Lepidocyrtus (L.) *curvicollis* (Bourlet, 1839) Bourlet, 1841

Distribution: India (Maharashtra, Uttar Pradesh, Uttarakhand*, West Bengal*, Arunachal*, Andhra Pradesh*, Andaman and Nicobar Islands*).

Lepidocyrtus (L.) *robustus* Imms, 1912

Distribution: India (Kerala).

Lepidocyrtus (L.) *orientalis* Handschin, 1929

Distribution: India (Tamil Nadu).

Subgenus *Setogaster* Salmon, 1951

Lepidocyrtus (S.) *indicus* (Handschin, 1929) Wang, Chen, and Christianan, 2003

Distribution: India (Tamil Nadu).

Lepidocyrtus (S.) *manipuri* (Salmon, 1969)

Distribution: India (Manipur).

Genus *Lepidiaphanus* Salmon, 1949

Lepidiaphanus kashmirensis Arora and Singh, 1962

Distribution: India (Jammu and Kashmir).

Genus *Pseudocyrtus* Salmon, 1956

Pseudocyrtus dentatus Prabhoo, 1967

Distribution: India (Kerala).

Pseudocyrtus salmoni Prabhoo, 1967

Distribution: India (Kerala).

Pseudocyrtus projectus Salmon, 1956

Distribution: India (Kerala).

Subfamily Seirinae Ssensu Deharverg, 2004

Genus *Corynothrix* Tullberg, 1877

Corynothrix borealis Tullberg, 1877

Distribution: India (Ladak, Jammu and Kashmir*)

Genus *Drepanosira* Bonet, 1942

Drepanosira frigida (Imms, 1912)

Distribution: India (Uttarakhand).

Drepanosira subornata (Denis, 1936) Bonet, 1942

Distribution: India (Jammu and Kashmir, Uttar Pradesh*).

Drepanosira hussi Neuhertz, 1976

Distribution: India (Himachal Pradesh*).

Drepanosira raviensis Baquero, Mandal and Jordana, 2015

Distribution: India (Himachal Pradesh).

Drepanosira shimlaensis Baquero, Mandal and Jordana, 2015

Distribution: India (Himachal Pradesh).

Genus *Lepidosira* Schött, 1925

Lepidosira nilgiri (Denis, 1936)

Distribution: India (Nilgiri, Tamil Nadu).

Lepidosira unguerrata Salmon, 1970

Distribution: India (Sikkim, Uttarakhand*, Arunachal Pradesh*).

Genus *Seira* Lubbock, 1869

Seira arunachala Mitra, 1975

Distribution: India (Arunachal Pradesh)

Seira lateralis Yosii, 1966

Distribution: India (Maharashtra).

Seira indica (Ritter, 1911) Yosii, 1966

Distribution: India (Maharashtra, Kerala, West Bengal, Arunachal Pradesh, Assam, Nagaland, Uttar Pradesh*, Uttarakhand*, Jharkhand*, Andhra Pradesh*, Andaman and Nicobar Islands*).

Seira cooperi Handschin, 1929

Distribution: India (Nilgiri, Tamil Nadu).

Seira indianicus (Paliwal and Baijal, 1985)

Distribution: India (Uttar Pradesh).

Seira mandawericus (Paliwal and Baijal, 1985)

Distribution: India (Uttar Pradesh).

Seira keethumensis (Paliwal and Baijal, 1985)

Distribution: India (Uttar Pradesh).

Seira indra (Imms, 1912)

Distribution: India (West Bengal).

Seira cinerea Yosii, 1966

Distribution: India (Maharashtra).

Seira punctata (Ritter, 1911)

Distribution: India (Maharashtra).

Seira unifasciata (Denis, 1936)

Distribution: India (Jammu and Kashmir).

Seira delamarei Jacquemart, 1980

Distribution: India (Ladak, Jammu and Kashmir*).

Seira nidarensis Baquero, Mandal and Jordana, 2014

Distribution: India (Ladak, Jammu and Kashmir)

Seira hazrai Baquero, Mandal and Jordana, 2014

Distribution: India (Ladak, Jammu and Kashmir)

Seira prabhooi Baquero, Mandal and Jordana, 2015

Distribution: India (Himachal Pradesh).

Seira simbalwaraensis Baquero, Mandal and Jordana, 2015

Distribution: India (Himachal Pradesh).

Subfamily Willowsiinae Yoshi and Suhardjao, 1989

Genus *Janetschekbrya* Yosii, 1971

Janetschekbrya brahamides (Denis, 1936)

Distribution: India (Jammu and Kashmir).

Family Paronellidae Börner, 1913

Subfamily Cyphoderinae Börner, 1913, Ssensu Soto –Adams, 2008

Genus *Cyphoda* Delamare Deboutteville, 1948

Cyphoda limboxiphia (Börner, 1913)

Distribution: India (Maharashtra).

Genus *Cyphoderodes* Silvestri, 1910

Cyphoderodes mitrai Yosii, 1987

Distribution: India (Maharashtra).

Cyphoderodes dubius Börner, 1913

Distribution: India (Maharashtra).

Cyphoderodes ceylonicus Silvestri, 1910

Distribution: India (Maharashtra, Kerala*).

Genus *Cyphoderus* Nicolet, 1842

Cyphoderus albinus Nicolet, 1842

Distribution: India (Maharashtra).

Cyphoderus ganeensis Tyagi and Baijal, 1979

Distribution: India (Uttar Pradesh).

Cyphoderus javanus Börner, 1906

Distribution: India (West Bengal, Kerala, Rajasthan, Arunachal Pradesh*, Manipur*, Mizoram*, Sikkim*, Odisha*, Maharashtra*, Uttarakhand*, Andaman and Nicobar Islands*)

Cyphoderus rubiae Baijal, 1955

Distribution: India (Himachal Pradesh).

Cyphoderus sarojinii Bhattacharjee, 1985

Distribution: India (Meghalaya).

Cyphoderus assimilis Börner, 1906

Distribution: India (Assam).

Cyphoderus indicus Mandal, Suman and Bhattacharya, 2016

Distribution: India (Jharkhand).

Cyphoderus jharkhandensis Mandal, Suman and Bhattacharya, 2016

Distribution: India (Jharkhand).

Genus *Delamarerus* Mitra, 1977

Delamarerus immsi Mitra, 1977

Distribution: India (Odisha, Maharashtra*, Andhra Pradesh*).

Genus *Pseudocyphoderus* Imms, 1912

Pseudocyphoderus annandalei Imms, 1912

Distribution: India (Odisha, Maharashtra*, Andhra Pradesh*).

Pseudocyphoderus squamicaudus Silvestri, 1917

Distribution: India (Maharashtra, Odisha*).

Genus *Serroderus* Delamare Deb. 1948

Serroderus tridenticulatus Denis, 1948

Distribution: India (Maharashtra).

Subfamily Paronellinae Börner, 1913 sensu Soto-Adams *et al.*, 2008

Tribe *Callyntrurini* Mitra, 1993

Genus *Callyntrura* Börner, 1906

Callyntrura escheri (Handschin, 1929)

Distribution: India (Anamalai, Tamil Nadu).

Callyntrura semiviolacea (Handschin, 1929)

Distribution: India (Tamil Nadu, Odisha*).

Callyntrura ceylonica (Ritter, 1911) Mitra, and Dallai, 1980

Distribution: India (Kerala).

Callyntrura cingulata (Bonet, 1930)

Distribution: India (Maharashtra).

Callyntrura delamarei Mitra, 1974

Distribution: India (Odisha, Andhra Pradesh*).

Callyntrura lineata (Parona, 1892) Yosii, 1961

Distribution: India (Uttarakhand, Maharashtra, Himachal Pradesh*, Jammu and Kashmir*, West

Bengal*, Andhra Pradesh*, Jharkhand*, Chattisgarh*).

Callyntrura longicornis (Oudemans, 1890)

Distribution: India (Assam, Sikkim, Chattisgarh*).

Callyntrura carli (Handschin, 1929) Yosii, 1982

Distribution: India (Tamil Nadu).

Callyntrura nigerrima (Prabhoo, 1971) Mitra, 1974

Distribution: India (Kerala).

Callyntrura prabhooi Mitra, 1974

Distribution: India (Kerala).

Callyntrura serrata (Salmon, 1957)

Distribution: India (Sikkim, Andhra Pradesh*, Nagaland*, Tripura*, Chattisgarh*).

Callyntrura sudindica (Prabhoo, 1971) Mitra, 1974

Distribution: India (Kerala, Uttar Pradesh*).

Callyntrura fissisetosa (Handschin, 1929)

Distribution: India (Tamil Nadu).

Callyntrura variabilis Mitra, 1974

Distribution: India (Uttarakhand, Uttar Pradesh*)

Callyntrura vestita (Handschin, 1925) Yosii, 1982

Distribution: India (West Bengal, Andhra Pradesh*, Assam, Manipur*, Meghalaya, Nagaland*, Maharashtra*, Chattisgarh*, Jharkhand*).

Callyntrura zaheri Mitra, 1974

Distribution: India (West Bengal, Andhra Pradesh*, Chattisgarh*).

Callyntrura japonica (Kinoshita)

Distribution: India (Arunachal Pradesh, Manipur*, Meghalaya*, Mizoram*, Uttarakhand*, Andhra Pradesh*, Andaman and Nicobar Islands*).

Genus *Cyphoderopsis* Carpenter, 1917

Cyphoderopsis gracilis Carpenter, 1924

Distribution: India (Meghalaya).

Cyphoderopsis ceylonica Yosii, 1966

Distribution: India (Meghalaya, West Bengal*, Maharashtra*).

Cyphoderopsis sixocellata Yosii, 1966

Distribution: India (Maharashtra).

Cyphoderopsis decemocolata Prabhoo, 1971

Distribution: India (Kerala).

Cyphoderopsis kempi Carpenter, 1917

Distribution: India (Meghalaya).

Genus *Dicranocentroides* Imms, 1912

Dicranocentroides fasciculatus Imms, 1912

Distribution: India (Uttarakhand, Sikkim*, Arunachal Pradesh*, Manipur*, Mizoram*, Nagaland*, Tripura*, Uttar Pradesh*, Andaman and Nicobar Islands*).

Dicranocentroides flavescens Yosii, 1966

Distribution: India (Uttarakhand, West Bengal, Manipur*, Maharashtra*, Mizoram*, Nagaland*, Sikkim*, Tripura*, Arunachal Pradesh*, Uttar Pradesh*).

Dicranocentroides indica (Handschin, 1929)

Distribution: India (Assam, Meghalaya, Manipur*, Mizoram*, Nagaland*, Arunachal Pradesh*,

Collembola of India- An Updated Checklist

Sikkim*, Uttar Pradesh*, Andhra Pradesh*, Chattisgarh*).

Dicranocentroides gisini Mitra, 1975

Distribution: India (Uttar Pradesh, Nagaland*, Odisha*).

Dicranocentroides salmoni Mitra, 1975

Distribution: India (Assam, Meghalaya, Sikkim, Manipur*, Mizoram*, Nagaland*, Arunachal Pradesh*, Uttar Pradesh*, Uttarakhand*).

Dicranocentroides duduaensis Hazra and Mandal, 2015

Distribution: India (Uttar Pradesh).

Genus *Idiomerus* Imms, 1912

Idiomerus pallidus Imms, 1912

Distribution: India (Kerala).

Genus *Lepidonella* Yosii, 1960

Lepidonella ceylonica (Yosii, 1966) Dehanverg, and Bedos, 1995

Distribution: India (Maharashtra).

Lepidonella duodecimoculata (Prabhoo, 1971) Dehaveng, and Bedos, 1995

Distribution: India (Kerala).

Tribe *Cremastocephalini* Handschin, 1926

Genus *Pseudosalina* Mitra, 1974

Pseudosalina christianseni Mitra, 1974

Distribution: India (Uttarakhand, Himachal Pradesh*).

Pseudosalina multiformis Mitra, 1974

Distribution: India (Uttarakhand, Himachal Pradesh*, Andhra Pradesh*).

Pseudosalina nigrocephala (Mitra, 1966)

Distribution: India (Uttarakhand, Himachal Pradesh*).

Pseudosalina rapoportii Mitra, 1974

Distribution: India (Uttarakhand, Himachal Pradesh*).

Genus *Salina* MacGillivray, 1894

Salina bengalensis Mitra, 1973

Distribution: India (West Bengal, Maharashtra*).

Salina bicinctoides Yosii, 1960

Distribution: India (Maharashtra).

Salina biformis, Mitra, 1966

Distribution: India (Uttarakhand, Haryana, Himachal Pradesh *, Uttar Pradesh*).

Salina bulbosa (Salmon, 1957) Mitra, 1993

Distribution: India (Sikkim).

Salina celebensis (Schaeffer, 1898) Yosii, 1959

Distribution: India (Assam, Tamil Nadu, West Bengal*).

Salina choudhurii Mitra, 1973

Distribution: India (Meghalaya).

Salina dubiosa Denis, 1936

Distribution: India (Nilgiri, Tamil Nadu).

Salina grieta Tyagi and Baijal, 1979

Distribution: India (Uttar Pradesh).

Salina indica (Imms, 1912) Yosii, 1960

Distribution: India (Uttar Pradesh, West Bengal, Maharashtra*, Uttarakhand*, Himachal Pradesh*, Andaman and Nicobar Islands*).

Salina javana (Handschin, 1928) Yayuk, 1989

Distribution: India (West Bengal).

Salina montana (Imms, 1912)

Distribution: India (Uttar Pradesh, West Bengal, Maharashtra*, Andaman and Nicobar Islands*).

Salina quattuorfasciata (Handschin, 1928)

Distribution: India (Nilgiri, Tamil Nadu).

Salina sikkimensis Mitra, 1973

Distribution: India (Sikkim).

Salina striata (Handschin, 1928)

Distribution: India (Nilgiri, Tamil Nadu, West Bengal, Uttarakhand*, Andaman and Nicobar Islands*).

Salina tricolor (Handschin, 1928)

Distribution: India (Kerala, Uttarakhand*, Manipur*).

Salina yosii Salmon, 1964

Distribution: India (Odisha, West Bengal*).

Genus *Troglopedetes* Absolon, 1907, nec Joseph, 1872

Troglopedetes rasendrans Bhattacharjee, 1985

Distribution: India (Meghalaya).

Genus: *Yosiia* Mitra, 1967

Yosiia dehradunia Mitra, 1967

Distribution: India (Uttarakhand, Himachal Pradesh*, Jharkhand*, Tripura*, Arunachal Pradesh*, Sikkim*).

Order Symphypleona Börner, 1901 sensu Massoud, 1971

Family Arrhopalitidae Stach, 1956

Genus *Pygmarrhopalites* Vargovitsh, 2009

Pygmarrhopalites habei (Yosii, 1965) Vargovitsh, 2009

Distribution: India (Sikkim, Uttar Pradesh*).

Family Bourletiellidae Börner, 1912, Ssensu Bretfeld, 1994

Genus *Bourletiella* Banks, 1899

Bourletiella captis Baijal and Mathur, 1969

Distribution: India (Himachal Pradesh).

Bourletiella arvalis (Fitch, 1862)

Distribution: India (Jammu and Kashmir).

Bourletiella hortensis (Fitch, 1863)

Distribution: India (Himachal Pradesh).

Genus *Prorastriopes* Delamare Deboutteville, 1947

Prorastriopes spathaceus (Börner, 1907)

Distribution: India (Kerala).

Family Collophoridae Bretfeld, G, 1999

Genus *Collophora* Richards, Delamare Deboutteville and Masood, 1964

Collophora remanei Delamare Deboutteville, and Massoud, 1964

Distribution: India (Kerala).

Collophora mysticiosa Yosii, 1960

Distribution: India (Maharashtra).

Family Dicyrtomidae Börner, 1906

Subfamily Dicyrtominae Richards, 1968

Genus *Calvatomina* Yosii, 1966

Calvatomina bombayensis (Yosii, 1966)

Distribution: India (Maharashtra).

Calvatomina cruciata (Yosii, 1966)

Distribution: India (Maharashtra).

Calvatomina pagoda (Yosii, 1966)

Distribution: India (West Bengal).

Calvatomina pallida (Yosii, 1966)

Distribution: India (Maharashtra, Uttar Pradesh*).

Calvatomina trivandran (Prabhoo, 1971)

Distribution: India (Kerala).

Family Katiannidae Börner, 1913 **Sensu, Bretfeld, 1949**

Genus *Sminthurinus* Börner, C., 1901

Sminthurinus trinotatus Axelson, 1905

Distribution: India (Kerala, Uttar Pradesh*).

Subfamily Ptenothricinae Richards, 1968

Genus *Ptenothrix* Börner, 1906

Ptenothrix keralae Prabhoo, 1971

Distribution: India (Kerala).

Family Neelidae Folsom, 1896

Genus *Neelus* Folsom, 1896

Neelus murinus Folsom, 1896

Distribution: India (Kerala, West Bengal, Maharashtra).

Family Sminthuridae Lubbock, 1862, **Sensu Deharven*g*, 2004**

Subfamily Sminthurinae Lubbock, 1862, **Sensu Deharven*g*, 2004**

Genus *Pararrhopalites* Bonet and Tellez, 1947

Pararrhopalites anops Bonet and Tellez, 1947

Distribution: India (Kerala).

Pararrhopalites indianus Baijal and Agarwal, 1972

Distribution: India (Uttar Pradesh).

Genus *Sminthurus* Latreille in Sonnini (1802)

Sminthurus giantensis Baijal and Kohli, 1972

Distribution: India (Uttar Pradesh).

Sminthurus hamtaensis Baijal, 1958

Distribution: India (Himachal Pradesh).

Sminthurus kuluensis Baijal, 1958

Distribution: India (Himachal Pradesh).

Sminthurus parvullus Ritter, 1911

Distribution: India (Maharashtra, Kerala, West Bengal*).

Sminthurus pseudoviolaceus Ritter, 1911

Distribution: India (Maharashtra).

Sminthurus viridis (Linn. 1758) Bourlet, 1843

Distribution: India (Maharashtra, Kerala, West Bengal*).

Genus *Temeritas* Richards in Delamare

Deboutteville and Massoud, 1963

Temeritas bharatensis Baijal and Kohli, 1972

Distribution: India (Himachal Pradesh).

Temeritas dimna Mandal, Suman and Bhattacharya, 2016

Distribution: India (Jharkhand).

Subfamily Sphyrothecinae Betsch, 1980

Genus: *Parasphyrotheca* Salmon, 1951

Parasphyrotheca submagnificata Prabhoo, 1971

Distribution: India (Kerala).

Genus *Sphyrotheca* Börner, 1906

Sphyrotheca gangetica Yosii, 1966

Distribution: India (West Bengal, Maharashtra, Uttar Pradesh*).

Family Sminthurididae Börner, 1906

Genus *Sminthurides* Börner, 1900

Sminthurides antennatus Baijal and Verma, 1986

Distribution: India (Uttar Pradesh).

Sminthurides velli Prabhoo, 1971

Distribution: India (Kerala).

Sminthurides appendiculatus Imms, 1912

Distribution: India (West Bengal, Andhra Pradesh*).

Sminthurides parvulus (Krausbauer, 1898)

Distribution: India (West Bengal, Uttar Pradesh*).

Genus *Sphaeridia* Linnaniemi, 1912

Sphaeridia indica Prabhoo, 1971

Distribution: India (Kerala).

Sphaeridia biniserrata (Salmon) 1951 Massoud, 1964

Distribution: India (Kerala).

Sphaeridia pumilis (Krausbauer, 1898), Agrell, 1934

Distribution: India (Maharashtra, Kerala, West Bengal).

Genus *Stenacidia* Börner, 1906

Stenacidia violacea (Reuter, 1878)

Distribution: India (Maharashtra).

Acknowledgements

The author is grateful to the Director, Dr. Kailash Chandra, Zoological Survey of India, Kolkata for giving opportunity to study the materials and laboratory facilities. I am thankful to Shri K. C. Gopi, Scientist-F and Divisional In charge, Entomology Division for encouragement. Thanks are also due to all staff members of Apterygota Section namely Shri K.K.Suman, Senior Zoological Assistant, Shri

K.K.Bhattacharya, Senior Zool. Asstt. and Shri N.C. Maitra, Junior Zoological Assistant for their help and co-operation.

References

- Arora and Singh 1962. A new species of *Lepidiaphanus* from Kashmir (Entomo). Journal of Bombay Natural History Society 59(1): 309-311.
- Baijal, H.N. 1955a. Two new species of Collembola. Agra University Journal Research (Science) 4: 175-177.
- Baijal, H.N. 1955b. Entomological Survey of the Himalayas Part XI. - On Five New Species of Collembola. Agra University Journal of Research (Science) 4(2): 531-538.
- Baijal, H.N. 1956. Entomological survey of Himalayas: Part-IV. Two new species of Collembola. Agra University Journal of Research (Science) 4(1): 175-178.
- Baijal, H.N. 1958. Nival Collembolan from the North-West Himalaya. Proceedings National Academy of Science, Allahabad (India) 28: 349-360.
- Baijal, H.N. 1971a. On new species of the genus *Pararrhopalites* Bonet and Telbez (Collembola: Arrhopaliatini) from India. Zoologischer Anzeiger 189(1-2): 94-96.
- Baijal, H.N. 1971b. Indian species of *Sminthurus* Börner (Collembola: Sminthurinae). Zoologischer Anzeiger 189(5-6): 405-408.
- Baijal, H.N. and Verma, R. 1986. On a new species of Sminthurides (Collembola: Sminthuridae). Journal of Entomological Research (New Delhi) 10(1): 91-93.
- Baquero, E., Mandal, G.P. and Jordana, R. 2014. Singular fauna of Entomobryidae (Collembola from "Land of passes" at the Himalayas (Entomobryidae from Ladakh, India). Florida Entomologist 97(4):1554-1587.
- Baquero, E., Mandal, G.P. and Jordana, R. 2015. Entomobryoidea (Collembola) from Himachal Pradesh (India) in the Himalayas. Zootaxa 4027 (1): 001-041.
- Bellinger, P.F., Christiansen, K.A. and Janssens, F. (1996-2018). Checklist of the Collembola of the World. Available from: <http://www.collembola.org/taxa> (accessed 30th May, 2018).
- Bhattacharjee, R.K. 1985. Three new species of Collembola from North East India. Pan-Pacific Entomologist 61(4): 349-357.
- Bonet, F. 1930. Sur quelques Collembolles de L'Inde. Earth and space science news (Eos) 6: 249-273.
- Brown, J.M. 1932. A new species of *Proisotoma* from India. Proceedings of the Hawaiian Entomological Society 8: 35-36.
- Carpenter, G.H. 1917. Collembola: Zoological results of the Abor expedition 1911-1912. Records of Indian Museum, Calcutta 8: 561-568.
- Carpenter, G.H. 1924. Collembola of the Siju cave, Garo Hills, Assam. Records Indian Museum, Calcutta 25: 285-289.
- Cassagnau, P. 1980. Sur le genre *Assamanura* n. g. du nord-est de l'Inde et sur la lignée Uchidanurienne (Collembolles). Travaux du Laboratoire d'Ecologie des Arthropodes Edaphiques, Toulouse 2(3):1-7.
- Cassagnau, P. 1988. Les Collembolles Neanurinae des Massifs du sud de L'Inde et de Ceylan. Travaux du Laboratoire d'Ecologie des Arthropodes Edaphiques, Toulouse 5(4): 21-51.
- Cassagnau, P. 1990. Les Collembolles Neanurinae de l'Himalaya: I. Genres Synameria, *Singalimeria* et Stenomeria., Annales de la Société entomologique de France 26(1): 19-32.
- Choudhuri, D.K. and Roy, S. 1965. A new species of *Onychiurus* (Insecta: Collembola) from West Bengal. Revue d'Ecologie Et De Biologie Du Sol 2: 123-127.
- Denis, J.R. 1936. Yale North India-Expedition: Report on Collembola. Memoirs of the Connecticut Academy of Arts and Sciences 10: 261-282.
- Denis, J.R. 1947. Deux *Proisotoma* de l'Inde (Collembola). Proceedings of Royal Entomological Society London 16: 101-104.
- Handschin, E. 1925. Beitrage zur Collembolen fauna der Sundain seln. Treubia 6: 225-270.
- Handschin, E. 1929. Beitrage zur Collembolen fauna von Sud Indien. Revue Suisse de Zoologie, Geneva 36: 229-262.
- Hazra, A.K. and Mandal, G.P. 2007. Insecta: Apterygota: Collembola. Fauna of Andhra

- Pradesh. Zoological Survey of India, State Fauna Series 5(3): 87-104.
- Hazra, A.K. and Mandal, G.P. 2010. Insecta: Collembola. Fauna of Uttarakhand. Zoological Survey of India, State fauna series 18(2): 1-12.
- Hazra, A.K. and Mandal, G.P. 2012. Insecta: Collembola (Apterygota). Fauna of Andaman and Nicobar Islands. Zoological Survey of India, State fauna series 19(1): 7-14.
- Hazra, A.K. and Mandal, G.P. 2015. A New Species of *Dicranocentroides* (Collembola: Paronellidae) from India. Journal of Threatened Taxa 7(9): 7547-7551.
- Hazra, A.K., Mandal, G.P., Mitra, S.K. and Bhattacharyya, B. 2003. Insecta: Apterygota: Collembola. Fauna of Sikkim. Zoological Survey of India, State fauna series 9(2): 109-123.
- Hazra, A.K., Mandal, G.P., Mitra S.K. and Bhattacharyya, B. 2004. Insecta: Apterygota: Collembola. Fauna of Manipur. Zoological Survey of India, State Fauna Series 10: 51 – 66.
- Hazra, A.K., Mandal, G.P., Mitra, S. K. and Bhattacharyya, B. 2006a. Insecta: Collembola. Fauna of Nagaland. Zoological Survey of India, State fauna series 12: 67-74.
- Hazra, A.K., Mandal, G.P., Mitra S.K. and Bhattacharyya, B. 2006b. Insecta: Collembola. Fauna of Arunachal Pradesh. Zoological Survey of India, State fauna series 13(2): 55-65
- Hazra, A.K. and Mandal, G.P. and B. Bhattacharyya. 2007. Insecta: Apterygota: Collembola. Fauna of Mizoram. Zoological Survey of India, State fauna Series 14: 129-141
- Imms, A.D. 1912. On some Collembola from India, Burma and Ceylon with a catalogue of the Oriental species of the order. Proceedings of Zoological Society of London 1912: 80-125.
- Mandal, G.P. 2011. Collembola (Hexapoda) fauna from Bibhuti Bhushan Wild life Sanctuary, Parmadan, West Bengal, India. Records Zoological Survey of India 111(2): 61-66.
- Mandal, G.P. 2013. Two additional New Records of Collembola from Arunachal Pradesh, India. Bionotes 15(3): 85.
- Mandal, G.P. 2014. New records of Collembola (Hexapoda) from Hazaribagh National Park, Jharkhand. Biological Forum 6(2): 197-202.
- Mandal, G.P. 2018. A new genus of Heteromurinae (Collembola: Entomobryidae) with dental base falcate macrochaetae, from India, Halteres 9: 74-85.
- Mandal, G.P. and Hazra, A.K. 2004. On a collection of Collembola insects from Himachal Pradesh with Zoogeographical note. Bionotes 6(4): 116-117.
- Mandal, G.P. and Hazra, A.K. 2005. Notes on some Collembola (Apterygota: Insecta) from Rajasthan. Records Zoological Survey of India 104(1-2): 1-6.
- Mandal, G.P. and Hazra, A.K. 2009. The Diversity of Collembola (Hexapoda) from East and North East India with some notes on their Ecology. Records Zoological Survey of India, Occasional Paper.no. 298: 1-206.
- Mandal, G.P. and Suman K.K. 2013a. Collembola fauna from Sajnakhali Wild life Sanctuary, South 24pp., West Bengal, India. Prommalia 1: 69-78.
- Mandal, G.P. and Suman, K.K. 2013b. Collembola fauna from Simbalwara wild life sanctuary, Himachal Pradesh, India. Records Zoological Survey of India 113(3): 23-28.
- Mandal, G.P. and Suman, K.K. 2014. Collembola (Hexapoda) from Radhanagari Wild Life Sanctuary. Fauna of Radhanagari Wild Life Sanctuary, Conservation Area Series 52: 53-60.
- Mandal, G.P. and Suman, K.K. 2015. Insecta: Collembola (Apterygota). Zoological Survey of India. Fauna of Uttar Pradesh, State fauna Series 22(2): 139-155.
- Mandal, G.P. and Suman, K.K. 2016. First Record of Collembola (Hexapoda) from Chhattisgarh, India. Records Zoological Survey of India 116(1): 35-39
- Mandal, G.P. and Suman, K.K. 2017. Apterygota: Collembola. Faunal Diversity of Kalatop-Kajjair W.L.Sanctuary, H.P., India. Conservation Area series 55: 19-24.
- Mandal, G.P., Suman, K.K. and Bhattacharya, K.K. 2016. Four New Species of Springtails

- (Hexapoda: Collembola) from Jharkhand, India. Records Zoological Survey of India 116(1): 41-52.
- Mandal, G.P., Suman K.K. and Bhattacharya, K.K. 2017. Five New Species of Collembola (Isotomidae) from Jharkhand, India. Rec. Zool. Surv. India 117(2): 97-112.
- Mitra, S.K. 1966a. On some Indian Collembola with the description of a new species of *Xenylla* (Collembola: Hypogastruridae). Science and Culture, Calcutta 32: 210-211.
- Mitra, S.K. 1966b. Two new species of *Salina* Mac Gillivray (Collembola: Entomobryidae: Paronellinae) Journal of Entomology, New Delhi 28(1): 67-73.
- Mitra, S.K. 1967. A new genus and species of Indian springtail (Insecta: Paronellinae) Proceedings of Zoological Society, Calcutta 20: 43-47.
- Mitra, S.K. 1973a. A new Paronellinae genus of Indian spring tail (Collembola: Entomobryidae: Paronellinae) with the descriptions of three new species. Revue d Ecologie Et De Biologie Du Sol 10(3): 359-377.
- Mitra, S.K. 1973b. A revision of *Salina* MacGillivray, 1894 (Collembola: Entomobryidae) from India. Oriental Insects 7(2):159-202.
- Mitra, S.K. 1974a. On the post embryonic morphological differentiation including chaetotaxy in *Callyatrura* (*Handschinphysa*) *lineata* (Collembola: Entomobryidae: Paronellinae). Pedobiologia 14: 323.
- Mitra, S.K. 1974b. A critical study on some species of *Callyntrura* Börner, 1906 (Collembola: Entomobryidae: Paronellinae) from India. Revue d Ecologie Et De Biologie Du Sol 11(3): 397-439.
- Mitra, S.K. 1975. Studies on the genus *Dicranocentriodes* Imms (1912) (Collembola: Entomobryidae: Paronellinae) from India. Records Zoological Survey of India 71: 57-95.
- Mitra, S.K. 1976a. Some Collembola from Arunachal Pradesh (Entomobryidae). Oriental Insects 10(1): 145-150.
- Mitra, S.K. 1976b. A new genus and species of termitophilous Collembola (Entomobryidae: Cyphoderinae) from India. Revue d Ecologie Et De Biologie Du Sol 13(4): 645-652.
- Mukherjee, D. 1932. Description of a new species of Collembola and its anatomy. Records Indian Musuem 34: 47-49.
- Paliwal, A.K. and Baijal, H.N. 1985. Three new species of the genus *Lepidocyrtinus* Börner (Collembola: Entomobryidae) from India. Journal of Entomological Research 9(1): 94-99.
- Prabhoo, N.R. 1970. Two new records of soil Collembola from, South India. Journal of Bombay Natural History Society 70(3): 572-574.
- Prabhoo, N.R. 1971a. Soil and litter Collembola of South India. I. Arthropleona. Oriental Insects 5: 1-46.
- Prabhoo, N.R. 1971b. Soil and litter Collembola of South India. II. Symphypleona. Oriental Insects 5(2): 243-262.
- Prabhoo, N.R. 1971c. Bark and moss inhabiting Collembola of South India. Bulletin of Entomology 12(1): 41-47.
- Prabhoo, N.R. and Muraleedharan, 1980. A new species of *Tomocerus* (S.str.) (Tomoceridae: Collembola) from India. Entomon 5(3): 207-210.
- Ritter, W. 1910. Neue Thysanuren und Collembolen aus Ceylon und Bombay, gesammelt von Dr. Uzel, Annalen des Naturhistorischen Hofmuseums 24: 379-398.
- Salmon, J.T. 1956a. On two Hypogastroridae (Collembola) from India. Proceedings of Royal Entomological Society London (B) 25: 171-174.
- Salmon, J.T. 1956b. A new species of *Parafolsomia* (Collembola) from India. Proceedings of Royal Entomological Society London (B) 25: 127-128.
- Salmon, J.T. 1957a. Some Paronellinae (Collembola) from India. Acta Zoologica Cracoviensia 11(14): 313-362.
- Salmon, J.T. 1957b. A new species of Entomobryidae from India (Collembola). Proceedings of Royal Entomological Society London (B) 26: 49-50.
- Salmon, J.T. 1958. A new Onychiurid Collembola from India Proceedings of Royal Entomological Society London (B) 27: 145-146.

- Salmon, J.T. 1963. New Collembola Symphypleona from India and Australia. Bulletin of Royal Society of New Zealand 3(8): 81-84.
- Salmon, J.T. 1965. New Onychiurid Collembola from India and New Guinea. Transactions of the Royal Society of New Zealand, Zoology 5: 225-231.
- Salmon, J.T. 1969. New Collembola from India. Zoology publications from Victoria University College 51: 40-49.
- Salmon, J.T. 1970. Some new records and new species of Collembola from India. Bulletin of Royal Society of New Zealand 12(13): 145-152.
- Tyagi, N. and Baijal, H.N. 1978. Two new species of Collembola collected from sugarcane field of District Bijnore, Uttar Pradesh. Journal of Entomological Research 3(2): 177-181.
- Tyagi, N. and Baijal, H.N. 1982. Three New Species of Hypogastrura (Collembola: Hypogastrura) from India. Bulletin of Pure and Applied Sciences 1: 6-10.
- Yosii, R. 1966a. On some Collembola of Afghanistan, India and Ceylon, collected by the Kuphe Expedition, 1960. Research Kyoto University Science Expedition Karakoram and Hindukush 1955 8: 333-405.
- Yosii, R. 1966b. Collembola of Himalaya. Journal of the College of Arts and Sciences, Chiba University. (Natural Sciences Series) 4(4): 461-531.

Two new species of slant-faced grasshopper genus *Acrida* (Acrididae: Acridinae) from India

Sunil Kumar Gupta* & Kailash Chandra

Zoological Survey of India, Prani Vigyan Bhawan, 'M' Block, New Alipore, Kolkata-, 700053,
West Bengal, India.

(Email: skumarento@gmail.com)

Abstract

Two new species of genus *Acrida* viz. *A. raipurensis* sp. n. and *A. bhoramdevi* sp. n. are described from Central India and compared with known Asian species. Keys to the genus *Acrida* known from the Asian countries is also provided.

Keywords: *Acridoidea, taxonomy, new species, Raipur, Kabirdham.*

Received: 14 April 2017; Revised: 2 June 2018; Online: 8 June 2018.

Introduction

The genus *Acrida* is one of the most diverse genus of Orthoptera erected by Linnaeus in 1758 for Acridinae species *Gryllus turritus* and *G. nasutus*. Subsequently, Fabricius (1775) used the new name *Truxalis* for these two species, which was accepted by many workers. Burr (1902) published 21 species of *Acrida* genus of which, 6 were new. Later, Dirsh (1949) revised the genus *Acrida* from Western Palaearctic. Dirsh (1954) reviewed the genus *Acrida* and reported 23 species including 3 species new to science. Steinmann (1963) described 12 species of the genus *Acrida* from Africa and Asia. Presently, forty species (Eades *et al.*, 2017) are globally known, 17 species from Asia, 19 species from Africa, 1 species from Australian and 3 species and subspecies from Europe. In India only three species are known (Shishodia *et al.*, 2010). In the present paper, two new species viz. *Acrida raipurensis* sp. n. and *A. bhoramdevi* sp. n. are described.

Materials and Methods

Study area:

The survey was undertaken in Chhattisgarh state covering two protected areas i.e. Barnawapara Wildlife Sanctuary (BAWLS) and Bhoramdev Wildlife Sanctuary (BHWLS) with a covered area of 244.66 sq. km and 163.59 sq. km

respectively. The specimens were collected by sweeping over grassland and other vegetation by using insect net and killed by the benzene vapour. The specimens were preserved and pinned. The figures are captured using Nikon D 300S with 105 macro lens. The specimens were studied under Leica stereo-zoom Microscope (Leica M205 A). All the measurements are given in millimeters. The type specimens are deposited in the Central Entomological Laboratory (CEL) of the Zoological Survey of India, Kolkata.

Taxonomy

Order **ORTHOPTERA** Olivier, 1789
Suborder **CAELIFERA** Ander, 1936
Superfamily **ACRIDOIDEA** Macleay, 1821
Family **ACRIDIDAE** Macleay, 1821
Subfamily **ACRIDINAE** Macleay, 1821
Tribe **ACRIDINI** Macleay, 1821
Genus *Acrida* Linnaeus, 1758

Acrida raipurensis Gupta & Chandra sp. n.
(Figs.1-3)

urn:lsid:zoobank.org:act:FBA984B6-491B-42F6-BD94-4E3C96405E01

Material examined (5 specimens).

Holotype: (1/5) 1♂, Chhattisgarh, Raipur district, Devgaon village, 21°22'668"N, 82°24'837"E, 294 m, 20.vi.2013, coll. S. K. Gupta, Reg. No. 14959/H5.

Paratypes: (2-5/5): 1♂+3♀, same localities as holotype, Reg. No. 14960-63/H5.

Diagnosis: The new species is similar to *A. turrita*, but differs by a combination of following characters: mid carina of fastigium of vertex absent, antenna shorter than head and pronotum together, fastigium of vertex with long rounded apex, frons oblique, frontal ridge considerable depressed, broad, sulcate with lateral carinulae obtusely below median ocellus, subgenital plate broad, with obtuse apex and basal part with a obtusely long projection, in profile.

Description (Male): Body large in size and elongated (Fig. 1A,B), head considerably elongated, preocellar section (top of head), when viewed from above short, strongly obtuse, anterior margin in profile slightly concave, longer than pronotum in dorsal view (Fig. 2A). Fastigium of vertex slightly concave with lateral carinae slightly elevated (Fig. 2D). Vertex flat slightly concave without median carina. Eyes elongated, located near above middle of anterior part of head. Antennae ensiform, 17th segments, slightly shorter or subequal to head and pronotum together, length of middle segments 1.8 times its width. Frontal ridge depressed only anteriorly up to antennal grooves (Fig. 1C) after antennal grooves constriction then widened up to middle ocelli and below middle ocelli not reaching up to clypeus (Fig. 2C). Frontal ridge sub obsolete at clypeo-frontal suture.

Thorax: Pronotum 1.9 times as long as wide, disc with one transverse sulci, surface of the pronotum usually punctate, anterior margin of pronotum straight, posterior margin curved. Median carina slightly tectiform, lateral carinae parallel, straight in prozona, in metazona lateral carinae slightly incurved to posterior region, prozona shorter than metazona, transverse sulcus before the middle of pronotal disc; posterior margin of metazona obtusangulate (Fig. 2E). Mesosternal lobe shorter than its width (Fig. 2B).

Tegmen: Well developed, narrow, elongated, apex acute and exceeding tip of hind knee, hind wings developed and slightly shorter than tegmina.

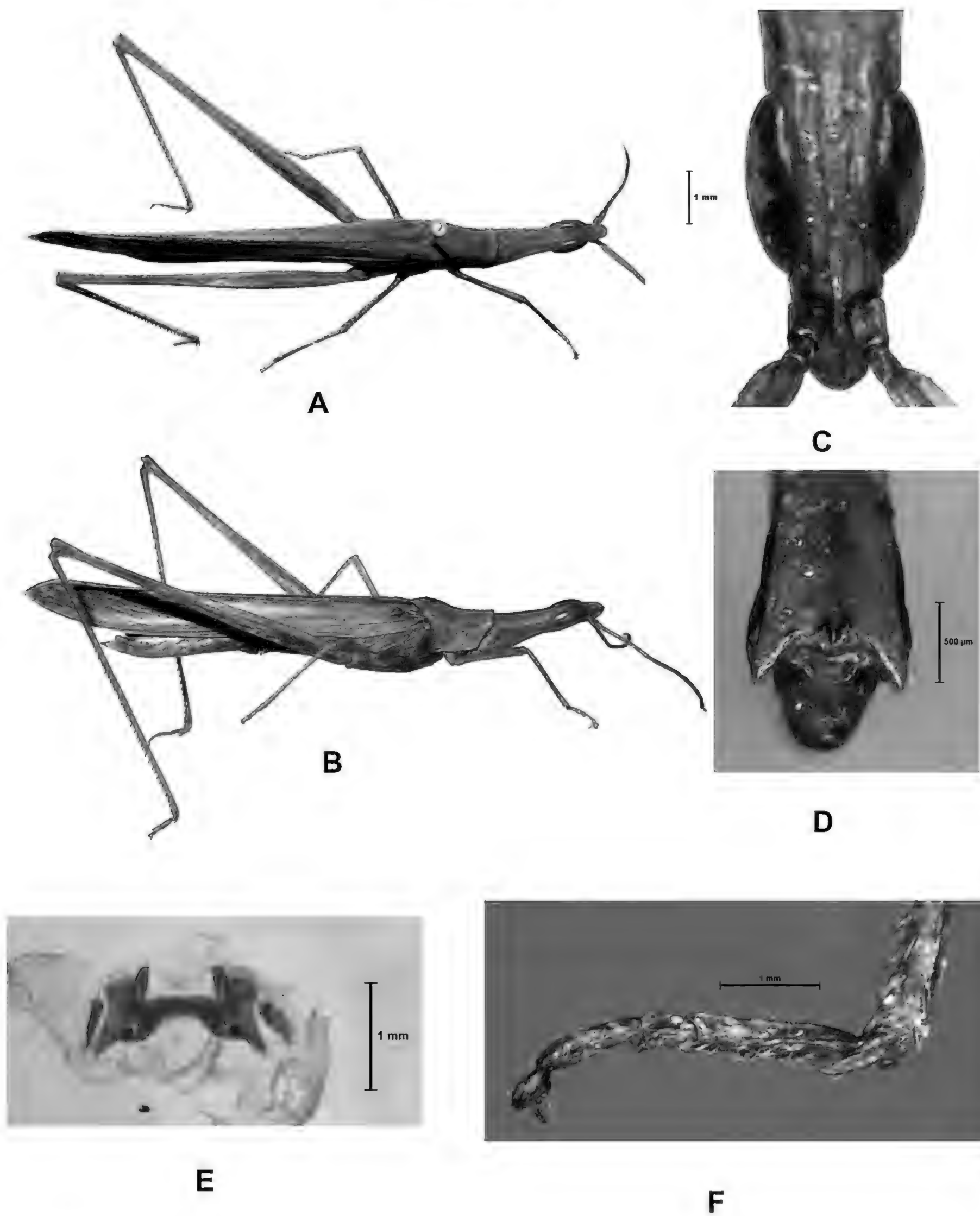
Legs: Hind femora long, tip of hind femora with a spine at the apex of hind knee. Hind tibiae slender with outer 31 small spines and inner 29 at dorsal margin; apical spine present at both sides (Fig. 1D). Apical spurs of hind tibiae more than 1.7 times as long as 2nd spurs, tip obtusely, slightly curved (Fig. 2F). First tarsal segment 3.6 times longer than second tarsal segment and slightly longer than third tarsal segment (Fig. 1F). Supra-anal plate triangular. Cerci longer than supra-anal plate. Subgenital plate broad, with obtuse apex and basal part with a obtusely long projection, in profile. Epiphallus bridge shaped (Fig. 1E); ancorae large, lophi lobiform and bilobate; lateral plate large.

Colour: Body greenish to yellowish. Antenna brown blackish, wings hyaline, tegmina and hind tibiae light green. Abdomen and subgenital plate brown with light yellowish colour.

Comparative notes: The new species differs from *Acrida turrita* by absence of mid carina on fastigium of vertex. Anterior region of fastigium strongly obtuse. Mesosternal lobe shorter than its width. In ventral region, subgenital tip obtuse. Frontal ridge anteriorly depressed with lateral carinae slightly narrow between antennae and parallel, widened up to median ocelli, below median ocelli obliterated. Antenna shorter than head and pronotum together. Transverse sulcus before the middle of pronotal disc; inner apical spurs of hind tibiae straight, tip obtusely, expanded. Subgenital plate broad, with obtuse apex and basal part with large projection, in profile. Male epiphallus differs from Dirsh, 1956, page no. 279, plate no. 53 fig. 4.

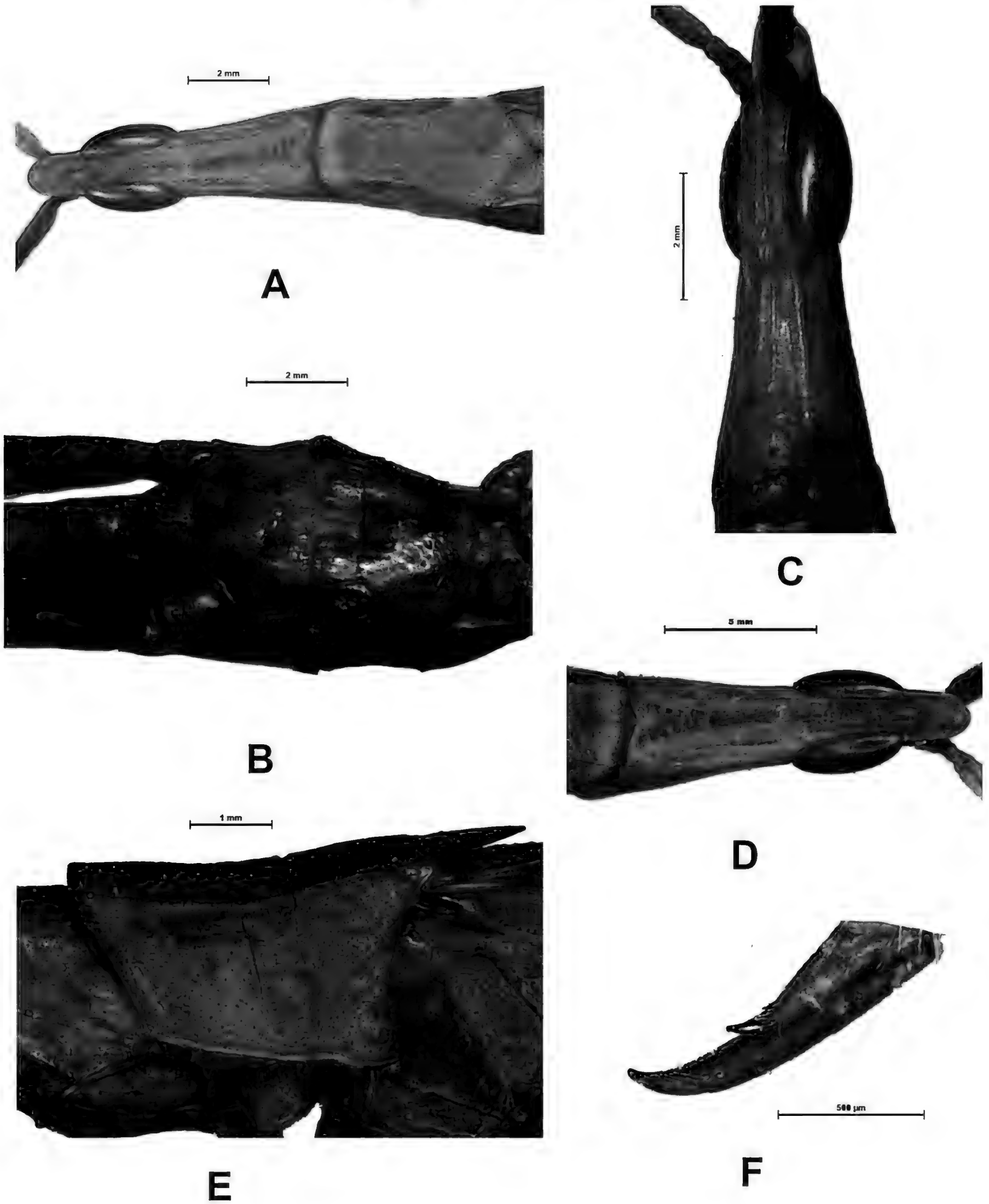
Measurements. Male: Body length 42.87; head length 9.820, width 3.468; antenna length 15.751, scape length 0.648, mid segment length 0.974, width 0.529; compound eye length 3.258, width 0.888; pronotum length 7.911, width 4.089; prozona length 3.955, metazona length 4.662; vertex 1.229; fastigium of vertex 1.538; mesosternal lobe length 1.447, width 1.693; tegmina length 41.132; subgenital plate length

Figures 1

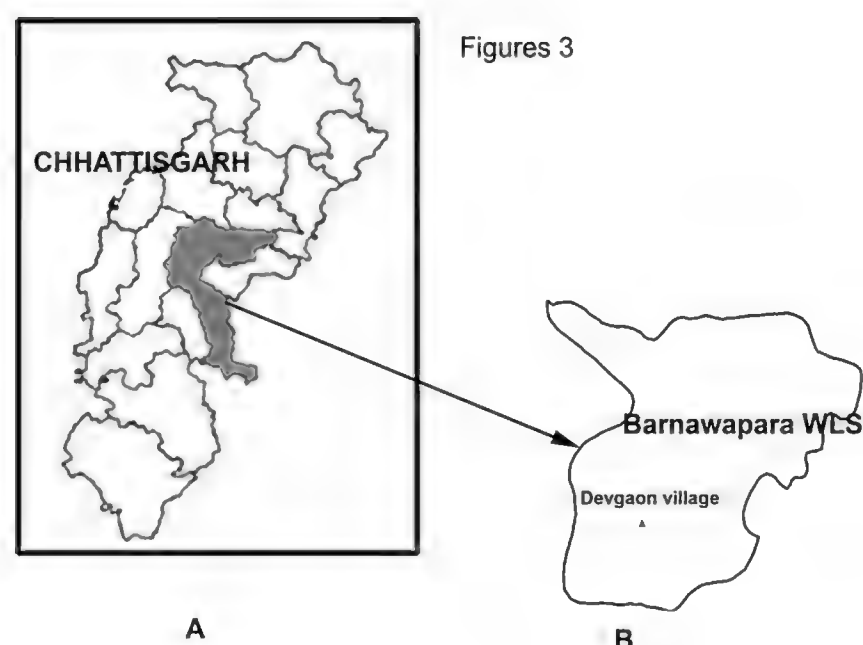


FIGURES 1A-F: *Acrida raipurensis* sp. n. male, A, dorsal view; B, lateral view; C, head showing frontal region (ventral view); D, Tip of hind femora with spine at the apex of hind knee (dorsal view); E, epiphallus; F, tarsal segments.

Figures 2



FIGURES 2A-F: *Acrida raipurensis* sp. n. A, Head and pronotum, dorsal view; B, mesosternal lobe; C, head showing frontal region (ventral view); D, fastigium of vertex (dorsal view); E, pronotum (lateral view); F, apical inner spurs.



FIGURES 3A-B. Distribution map of *Acrida raipurensis* sp. n. A, coloured area denotes Raipur district; B, Barnawapara Wildlife Sanctuary; triangle area denotes collection localities.

3.093, width 1.126, cerci length 1.352, width 0.372; fore leg: femur length 7.813, width 0.824; tibial length 5.28, width 0.648; tarsus length I 0.929, II 0.351; III 0.412; claws Ist length 1.536; mid leg: femur length 7.533, width 0.678, tibial length 8.905, width 0.500; tarsus length, I 1.486, II 0.404, III 1.363; hind leg: femur length 31.674, width 1.843; tibiae length 29.856, width 0.679; tarsus length I 2.880, II 0.691, III 1.751.

Female: Body length 55.14.

Etymology: The species has been named after the type locality.

Acrida bhoramdevi Gupta & Chandra sp. n.
(Figs. 4-6)

[urn:lsid:zoobank.org:act:7AC688B1-10CC-490B-AB7E-B73A56F49847](https://zoobank.org/act:7AC688B1-10CC-490B-AB7E-B73A56F49847)

Material examined (6 specimens).

Holotype: (1/6) 1♂, Chhattisgarh; Kabirdham, Bhoramdev WLS, Bodalpani forest, 22°01'777" N, 82°89'788" E, 722 m, 02.xii.2011, coll. S. K. Gupta & party, Reg. No. 14907/H5.

Paratypes (2-6/6): 1♂+1♀, same localities as holotype, Reg. No. 14908-09/H5; 1♀, 2♂, Chhattisgarh; Kabirdham, Bhoramdev WLS, Rajadhar forest, 22°13'611" N, 81°02'902" E, 742 m, 01.xii.2011, coll. S. K. Gupta & party, Reg. No. 14910-11-12/H5.

Diagnosis: Head elongated, antenna subequal or shorter than head and pronotum together. Fastigium of vertex large with apex subobtuse, lateral carina of pronotum, transverse sulcus before the middle of pronotum. Lateral carinae of pronotum in prozona, incurved, in metazona strongly excurved and divergent.

Description: Male: Body medium sized and elongated (Fig. 4A,B); head elongate, basal part wide, antennae ensiform, 17 segments, length of middle segments 1.2 times its width, shorter than head and pronotum together (Fig. 5A). Eyes elongated, head slightly longer than pronotum, acutely conical; fastigium of vertex wide, protruding, concave with parabolic apex and apparent carinula of vertex (Fig. 5B); frons, moderately incurved (Fig. 5D); Frontal ridge anteriorly angulate after depressed narrowly (Fig. 4C), sulcate, with lateral sides slightly constriction just below antennal grooves, after broad, gradually divergent forward and extend up to clypeus. Interocular space wider than frontal ridge.

Pronotum: (Fig. 5C) Pronotum, 2 times longer than wide, flat with single transverse sulcus, median and lateral carinae distinctly coarse and scabrous. Prozona shorter than metazona. Lateral carinae of pronotum in prozona, incurved, in metazona strongly excurved and divergent. Transverse sulcus before the middle of pronotum; posterior margin of metazona obtusely angular.

Tegmen: produced well beyond the hind knee, with apical part slightly parabolic (Fig. 5F). Wings slightly shorter than tegmen with apex obtuse. Lateral lobe of hind knee, short and acute.

Legs: Mesosternal interspace open, mesosternal lobe much wider than long, hind femora and tibiae elongated; hind femora 1.2 times longer than abdomen, tip of hind femora with small spine at the apex of hind knee (Fig. 5G); hind tibiae with 26 inner and 25 outer spines, inner and outer apical spurs distinct, one pair outer apical spurs and one pair inner apical spurs; outer apical spurs equal length but inner 2nd apical spur more than twice longer than 1st apical spur (Fig. 5E). First tarsal segment 2.8 times longer than second tarsal segment and 1.5 times longer than third tarsal segment. Supra-anal

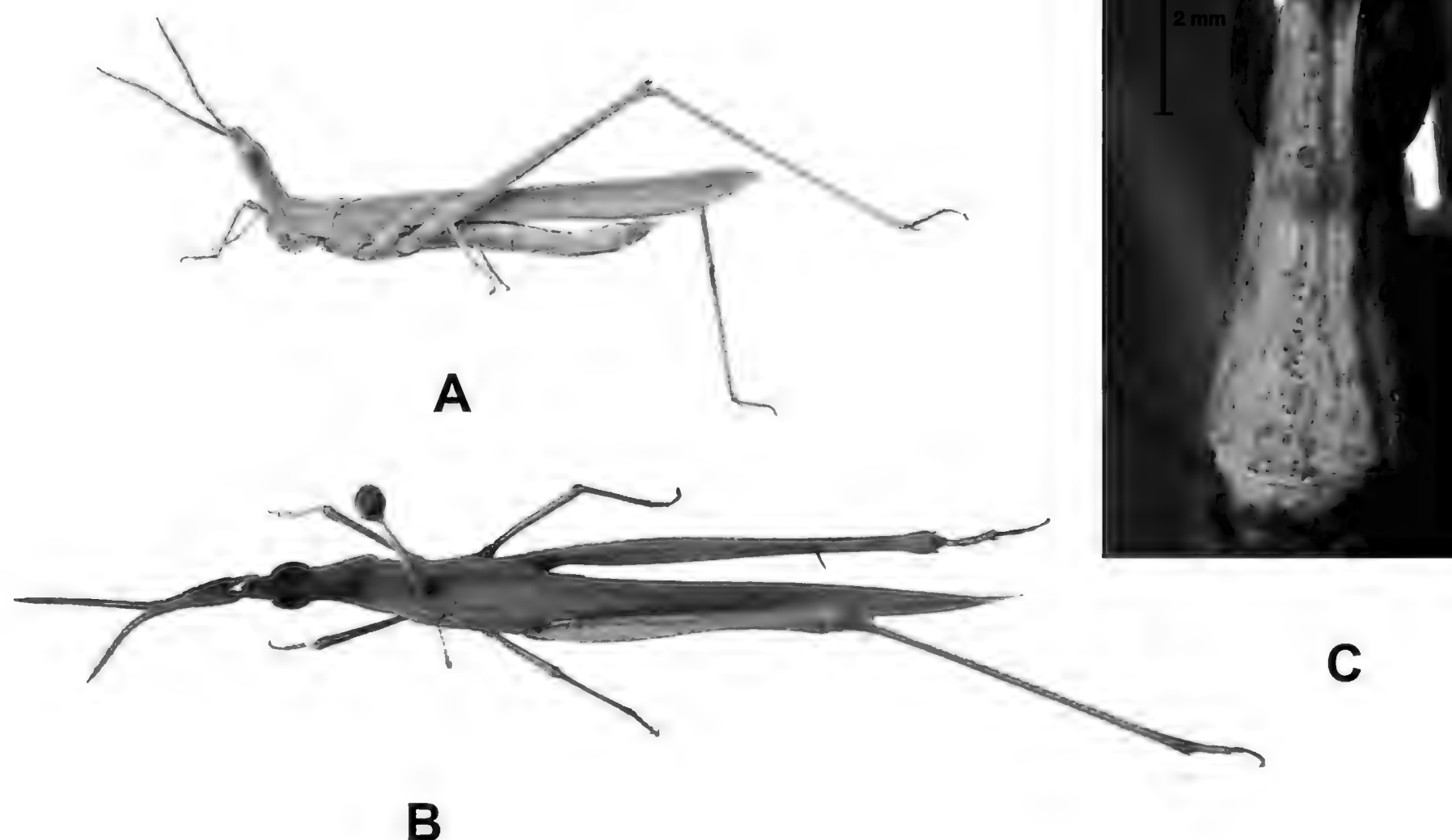
plate 2 times longer than broad. Subgenital plate 1.6 times longer than broad, with obtuse apex and with large obtuse projection in the basal part, with white long hairs (Fig 5I). Cerci slender, blunt, rounded tip, long hairs. Epiphallus with broad bridge, ancorae large lophi small and bilobate. (Fig. 5H).

Female: Very similar to male but larger in size. Supra-anal plate obtuse angular; body much longer and robust than male; subgenital

plate conical, ovipositor valve short, slightly curved.

Colour: Body straw yellow, faint with small black, with brown striped head, pronotum and tegmina. Head and pronotum with blackish-brown dots or granules. Antennae with alternating light and dark brown bands. Abdomen and subgenital plate brown with light yellowish, and 6, 7, 8 sternite ventral margin dark brown coloured. Tip of spines black.

Figures 4

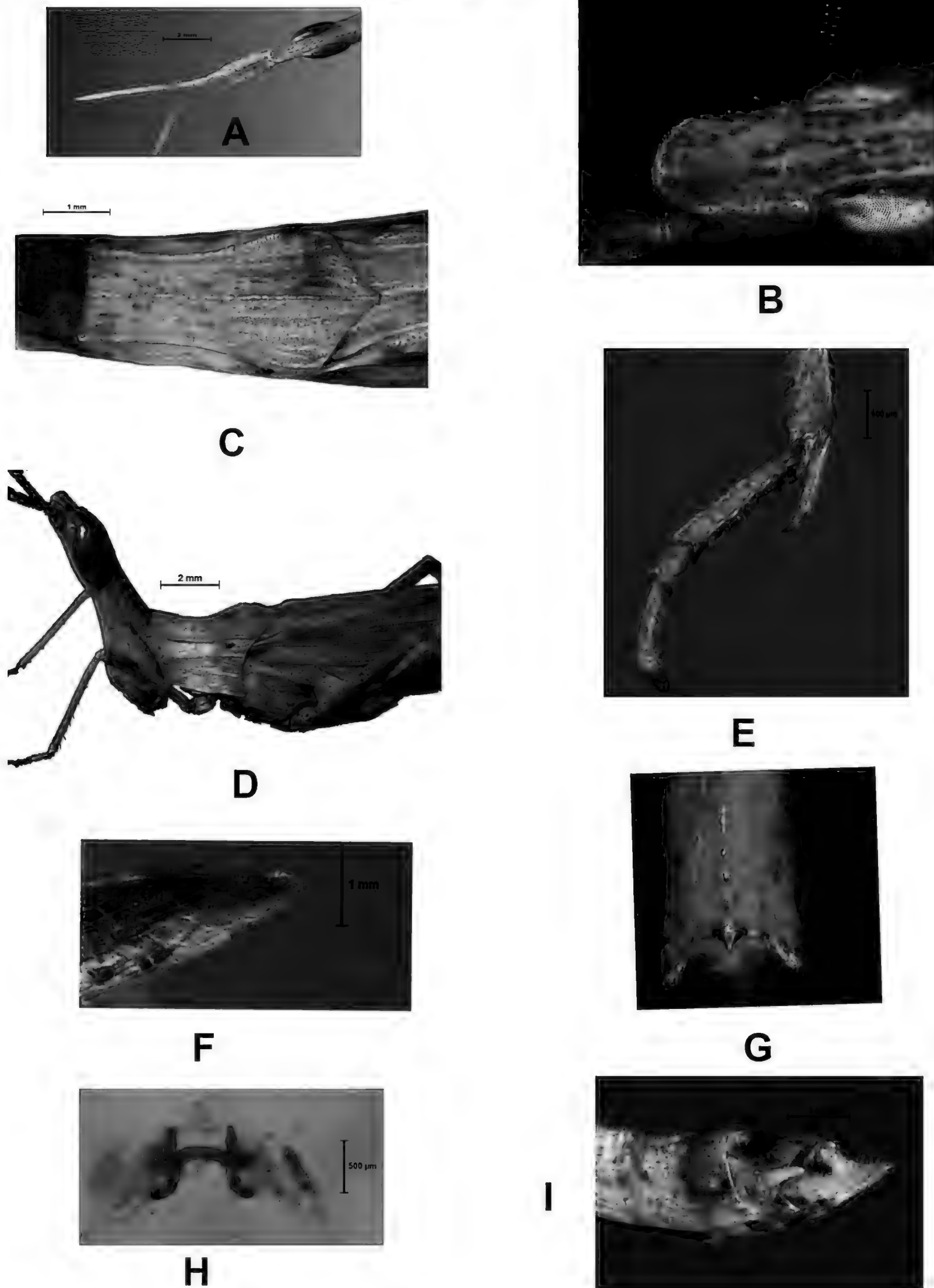


FIGURES 4A-C: *Acrida bhoramdevi* sp. n. male, A, lateral view; B, dorsal view; C, head showing frontal region (ventral view)

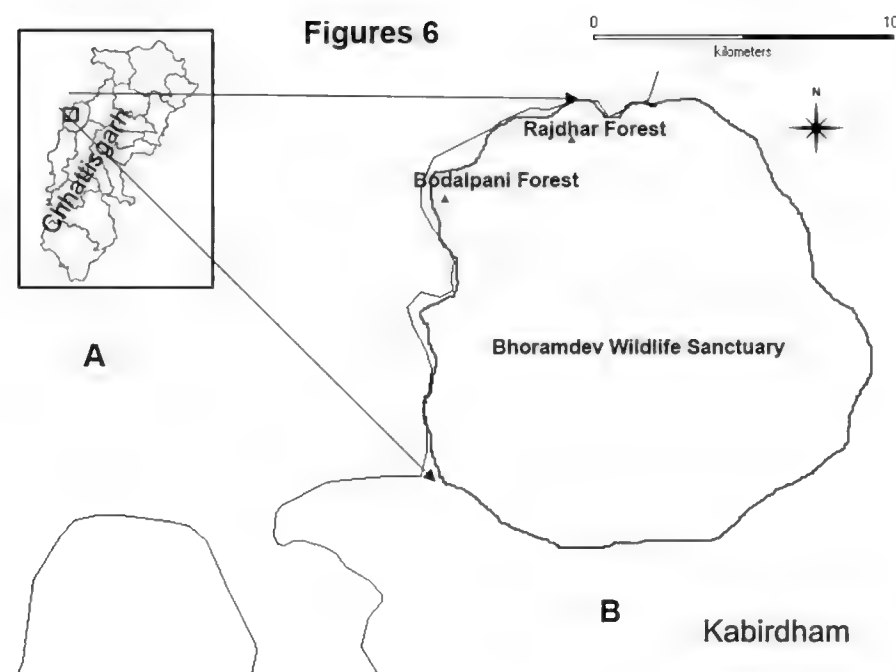
Comparative notes: The new species is similar to *Acrida exaltata*, but differs by slightly shorter body length; slender, dry grass colour, head longer than pronotum. Prozona shorter than metazona. Posterior margin of metazona obtusangular with obtuse apex. Tegmen produced well beyond the hind knee. Tip of hind

femora with small spine at the apex of hind knee. Apical spur of hind tibiae more than twice as long as 2nd spur, tip slightly acute, straight. Mesosternal lobe much wider than long. Subgenital plate broad, with obtuse apex and basal part with large projection, in profile.

Figures 5



FIGURES 5A-I: *Acrida bhoramdevi* sp. n. A, Antenna (dorsal view); B, Fastigium of vertex (dorsal view); C, pronotum (dorsal view); D, head and Pronotum; E, hind apical inner spurs; F, tegmen apex; G, Tip of hind femora with small spine at the apex of hind knee (dorsal view); H, Epiphallus ; I, subgenital plate.



FIGURES 6A-B. Distribution map of *Acrida bhoramdevi* sp. n. A, Chhattisgarh; sphere area denotes Kabirdham district; B, Bhoramdev Wildlife Sanctuary; triangle area denotes collection localities.

Measurements: Male: Body length 27.546, head length 5.562, width 1.241; antenna length 7.488, scape length 0.583, width 0.462, mid segment length 0.502, width 0.410; compound eye length 2.073, width 0.694; pronotum length 4.326; width 2.01; prozona length 1.984, width 1.426; metazona length 2.335, width 2.171; interocular space 0.814, vertex 0.674; fastigium of vertex 0.787; pronotum height (lateral view) 1.713; mesosternal lobe length 0.850, width 0.937; metasternal lobe length 0.675, width 2.164; tegmina length 25.088; abdomen length 13.683, supra-anal plate length 1.174; width 0.506; subgenital plate length 1.658, width 1.00, cerci length 0.762, width 0.297; fore leg: femur length 2.554, width 0.378; tibiae length 2.714, width 0.257; tarsus length I 0.660, II 0.293; III 0.926; claws Ist length 0.313; mid leg: femur length 4.459, width 0.393; tibiae length 5.072, width 0.295; length tarsus I 0.783, II 0.252, III 0.726; hind leg: femur length 16.398, width 1.052; tibiae length 15.371, width 0.248; length tarsus I 1.524, II 0.531, III 0.959.

Female: Body length 43.42.

Etymology: The species has been named after the Bhoramdev Wildlife Sanctuary (type locality).

Key to the known Asian species of genus *Acrida* Linnaeus, 1758

1. Head strongly elongated, from above and in profile, narrow in the basal part, combined length of prozona and metazona of dorsal plate of pronotum twice as long as wide17
- Head slightly elongated, from above and in profile, robust with broad in the basal part, combined length of pro- and metazona of dorsal plate of pronotum without twice as long as wide.....2
2. Elytron very strongly elongated and narrowed; wing very narrow, considerably shorter than elytron, dull, semipellucid.....
.....*A. lineata* (Thunberg)
- Elytron less elongated and border; wing comparatively broader, insignificantly shorter than elytron lustrous pellucid.....3
3. The projection on the upper margin of the subgenital plate, in profile, comparatively small.....4
- The projection on the upper margin of the male subgenital plate, in profile, very large, finger-shaped.....*A. indica* Dirsh
4. Elytron with subacute apex. Lateral carinae of pronotum in prozona straight and slightly convergent towards head, in metazona slightly excurved. Large and robust.....
.....*A. cinerea* (Thunberg)
- Elytron with broadly parabolic apex. Lateral carinae of pronotum almost straight and almost parallel in their whole length.....5
5. Lateral carina of pronotum inflated in prozona. Projection on upper margin of male subgenital plate apically blunt male 32-38mm, female 54-62mm.....
.....*A. anatolica* Dirsh
- Lateral carina of pronotum visibly arcuate in metazona. Projection on upper margin of male subgenital plate apically truncate male (31-53), female 51-80mm.....6
6. Subgenital plate short; apex short, blunt.....*A. formosana* Steinmann
- Subgenital plate long, apex slightly large.....7
7. Inner margin of triangular plate at tympanal aperture straight, its corner rounded. Upper margin of male subgenital plate straight, eventually slightly bent. Metazona (of a

- lobate shape) of female wide, even its smallest width greater than long.....11
- Inner margin of triangular plate at tympanal aperture straight, its corner acute-angled, or sinuous and broadly rounded. Lobe-shaped female metazona narrow, its smallest width equalling its length. Upper margin of male subgenital plate strongly concave or convex; plate either bending upward or deflected.....8
8. Male subgenital plate bending upward; its upper margin strongly concave.....9
- Male subgenital plate slightly or strongly deflected; its upper margin convex.....11
9. Inner margin of triangular plate at tympanal aperture sinous, its corner broadly rounded*A. granulata* **Mishchenko**
- Inner margin of triangular plate at tympanal aperture straight, its corner acute angle.....*A. incallida* **Mishchenko**
10. Anterior margin of lateral lobe of pronotum broken (well discernible when viewed laterally), its posterior margin arcuately incised. Basal joints of antennae wide. Apex of male subgenital plate slightly deflected, tooth shaped projection on its upper margin thumb-shaped; lower margin of plate slightly concave, almost straight.....*A. shanghaica* **Steinmann**
- Anterior margin of lateral lobe of pronotum slightly broken (when viewed laterally), its posterior margin brokenly incised. Basal joints of antennae narrow. Apex of male subgenital plate strongly deflected, fang like; tooth-shaped projection on its upper margin anvil-shaped; lower margin of plate strongly sinous.....*A. hsiai* **Steinmann**
11. Lateral carina of pronotum sinuously decurrent. Upper and lower margins of male subgenital plate subtending an angle of about 30°; apex of plate slightly curved. Lobe-shaped metazona of female pronotum exceedingly wide, its smallest width greater than its length.....*A. kozlovi* **Mishchenko**
- Lateral carinae of pronotum straight. Upper and lower margins of male subgenital plate subtending an angle of about 45°; apex of plate blunt. Lobe-shaped metazone of female pronotum wide, but as wide as long only at its widest portion.....12
12. Angular projection on upper margin of male subgenital plate low, apex of basal plate 3.5-4 times as great as length of protruding portion. Lateral ribs of pronotum high, lobately extending from plane of segment; posterior corner slightly elongated...*A. montana* **Steinmann**
- Angular projection on upper margin of male subgenital plate high.....13
13. Tibia 1 and 2 partly, tibia 3 entirely, red. Anterior margin of lateral lobe (deflected laterally) of pronotum straight (when viewed laterally), its posterior margin concave, not incised. Projection on upper margin of male subgenital plate blunt, flat, saddle-shaped.....*A. rufipes* **Steinmann**
- Legs yellow to yellowish red. Anterior margin of lateral lobe of pronotum considerably or slightly broken (when viewed laterally), posterior margin arcuately or brokenly incised. Projection on upper margin of male subgenital plate tooth shaped, high; projection dactyloid or anvil-shaped.....14
14. Male subgenital plate long, narrow; a minute, reclinate, semicircular protuberance on a rounded, triangular, blunt peg situated on upper margin of plate. Central projection on posterior margin of abdominal subgenital plate of female slightly longer than lateral ones.....*A. tjiamuica* **Steinmann**
- Male subgenital plate short.....15
15. Male subgenital plate, in profile with a large projection on the upper margin.....*A. willemsei* **Dirsh**
- Male subgenital plate, in profile with a small projection on the upper margin16
16. Pronotum, lateral carinae without a black line.....18
- Pronotum, lateral carinae within a black line*A. gigantea* (**Herbst**)
17. Mid carinae present on fastigium of vertex.....*A. turrita* (**Linnaeus**)
- Mid carinae absent on fastigium of vertex.....*A. raipurensis* **sp. n.**
18. Posterior margin of metazona obtuse angulate, abdominal tergites yellowish.....*A. bhoramdevi* **sp. n.**
- Posterior margin of metazona acute angulate, abdominal tergites reddish or pinkish*A. exaltata* (**Walker**)

Conclusion and Discussion

The difference between *A. raipurensis* **sp. n.** with *A. turrita* and *A. bhoramdevi* **sp. n.**

with *A. exaltata* were analyzed. The difference was found in 1) fastigium of vertex, 2) frontal ridge, facial carina, 3) pronotal morphology, 4) shape and size of apical spurs of hind tibiae, 5) subgenital plate, 6) cerci and 7) hind femoral tip.

The colour pattern and morphometry of the body varies between *A. raipurensis* **sp. n.** and *A. bhoramdevi* **sp. n.** The colour of *A. raipurensis* **sp. n.** is light green, while *A. turrita* is dark green. *A. bhoramdevi* **sp. n.** is straw yellow colour, while, *A. exaltata* is green. According to Dirsh, (1954), the body length *A. turrita* is 40.4 to 57.8, pronotum length 6.2-8.8; tegmen length 33.4-50.5; hind femur length 24.4-35.3, while the specimens of *A. raipurensis* **sp. n.** body length 42.87; pronotum length 7.911; tegmina length 41.132; femur length 31.674. According to Dirsh, (1954) *A. exaltata* (male) body length 28.5-37.0; pronotum length 5.0-6.0; tegmen length 23.5-34.0; hind femur 18.5-22.0; while *A. bhoramdevi* **sp. n.** body length 27.546; pronotum length 4.326; tegmina length 25.088; femur length 16.398.

Comparatively the size of *A. raipurensis* **sp. n.** is large, slender, greenish, head longer than pronotum, strongly elongated, dark greenish, head and pronotum subequal in *A. turrita*; subgenital plate broad, with obtuse apex and basal part with large projection in case of *A. raipurensis* **sp. n.**, while subgenital plate elongated with long acute angulate apex with strongly subacute projection in upper basal half in *A. turrita*. Hence the new species of *Acrida* i.e. *A. raipurensis* **sp. n.** is described as new to science.

Compared the morphological characters like tip of hind femora with small spine at the apex of hind knee in *A. bhoramdevi* **sp. n.** with the tip of hind femora with large spine at the apex of hind knee in *A. exaltata*. Body medium sized, slender, straw yellow colour, head longer than pronotum in *A. bhoramdevi* **sp. n.** while body medium, slender, greenish, head and pronotum of equal length in *A. exaltata*; prozona shorter than metazona in *A. bhoramdevi* **sp. n.** while prozona longer than metazona in *A. exaltata*; posterior margin of metazona obtuse angular with obtuse apex in *A. bhoramdevi* **sp. n.** while posterior margin of metazona acute angular with pointed apex in *Acrida exaltata*.

Thus *Acrida bhoramdevi* **sp. n.** is considered to be a separate species new to science.

Acknowledgements

The authors are grateful to Director, Zoological Survey of India, Kolkata, for providing necessary facilities and encouragements. The first author is grateful to Ministry of Environment, Forest and Climate Change, Government of India for the funding. The first author is grateful to Dr. D. Suresh Chand and all staff of Orthoptera section for their support and to the reviewers for their valuable comments and suggestions.

References

- Burr, M. 1902. A monograph of the genus *Acrida* (Stal), Truxalis Fabr., with notes of some allied genera and descriptions of new species. The Transactions of the Entomological Society of London 149-187.
- Dirsh, V.M. 1949. Revision of Western Palaearctic species of the genus *Acrida* Linne (Orthoptera: Acrididae). Eos, Revista espanola de Entomologia 25: 15-47.
- Dirsh, V.M. 1954. Revision of species of the genus *Acrida* Linnè. Bulletin de la Societe Fouad Ier D' Entomologie 38: 107-160.
- Dirsh, V.M. 1956. The phallic complex in Acridoidea (Orthoptera) in relation to taxonomy. Transactions of the Royal Entomological Society of London 108(7): 223-356. (Plates 66)
- Eades, D.C., Otte, D., Cigliano, M.M. & Braun, H. 2017. Orthoptera Species File. version 5.0./5.0. [accessed on 18th February 2017] <http://Orthoptera.SpeciesFile.org>
- Fabricius, J.C. 1775. *Systema entomologicae sistens Insectorum classes, ordines, genera, species, adjectis synonymis, locies*. Flensburg et Leipzig, 832pp.
- Linnaeus, C. 1758. *Systema Naturae per Regna Tria naturae* (10th ed.), 8 +722 pp.
- Steinmann, H. 1963. New species of the genus *Acrida* L. (Orthoptera) from Africa and Asia. Acta Zoologica, Hungry Budapest 9(3-4): 403-427.
- Shishodia, M.S., Chandra, K. & Gupta, S.K. 2010. An annotated checklist of Orthoptera (Insecta) from India. Records of the zoological Survey of India, occational Paper 314: 1-366.

Short communication

First verified record of genus *Onesia* (Diptera: Calliphoridae) from India

Meenakshi Bharti

Department of Zoology and Environmental Sciences, Punjabi University, Patiala, Punjab, India.

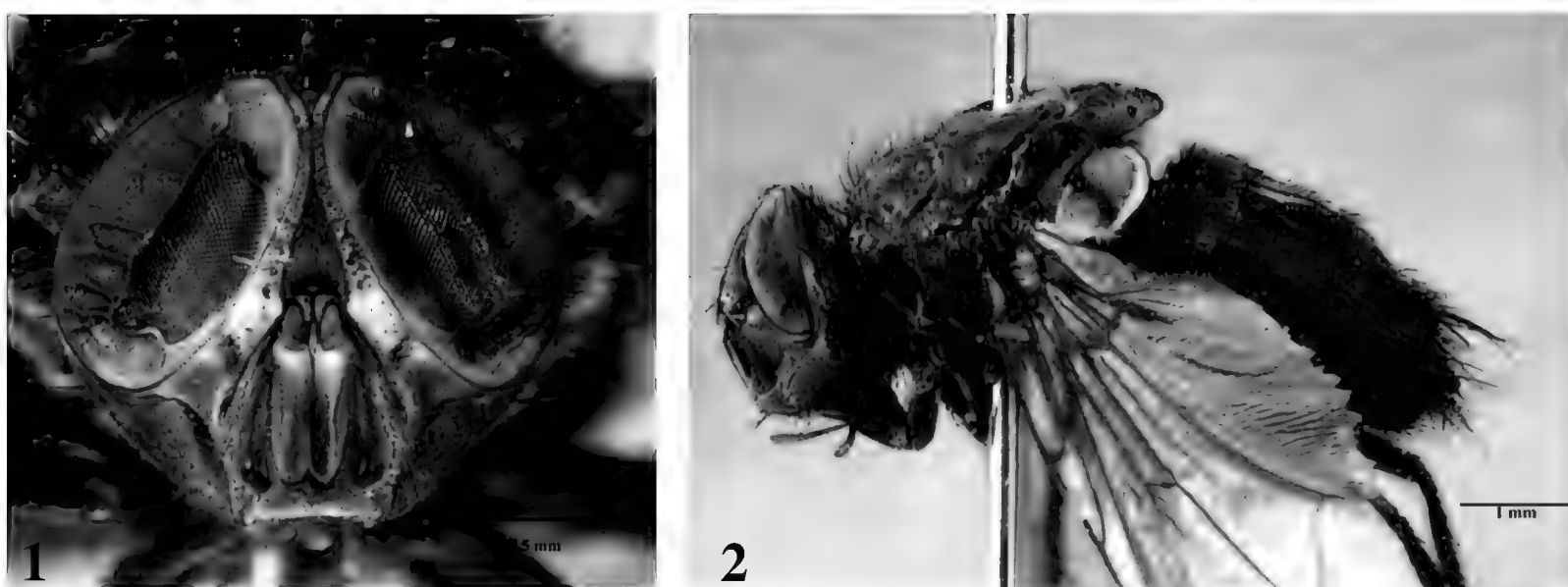
(Email: adubharti@gmail.com)

Keywords: *Diptera, Calliphoridae, Genus Onesia, new record, India.*

Received: 14 August 2018; Revised: 2 September 2018; Online: 12 September 2018.

Generic group *Onesia* of subfamily Calliphorinae (family Calliphoridae) is an assemblage of species of genera *Bellardia* Robineau-Desvoidy, 1863, *Onesia* Robineau Desvoidy, 1830, *Polleniopsis* Townsend, 1917, *Tainanina* Villeneuve, 1927 and *Tricycleopsis* Villeneuve, 1927. So far, from India the group is only represented by species of *Bellardia*, *Polleniopsis* and *Tainanina* (Verves, 2005; Bharti, 2015; Bharti & Verves, 2016). The present study herein reports the first verified record of genus *Onesia* from India.

Genus *Onesia* Robineau-Desvoidy, 1830 is represented by 61 species from the World, with 28 Palearctic, 23 Australasian/Oceanian, 7 Oriental, while two are common to Palearctic and Oriental regions, and one to Australasian and Oriental regions (Rognes, 1991, 1997, 1998; Schumann 1964, 1974, 1986; Verves, 2004, 2005; Verves & Khrokalo 2006; Xue *et al.*, 2006). *Onesia* flies are viviparous and the larvae are thought to be parasites or predators of earthworms or snails (Schumann, 1964), however these type of associations are yet to be verified (Rognes, 1991). The species in question, *Onesia atripalpis* (Malloch, 1935) was earlier recorded from Malaysia and Philippines and during the present study it has been collected from western Himalaya (Nanda Devi and Valley of flowers National Park, Uttarakhand, India) at an altitude of 3500m. Notably, the park is an abode to numerous endemic species of plants and animals and is recognised as World Heritage Site by UNESCO.



Figures 1-2: *Onesia atripalpis*: 1. Head front view; 2. Profile

Acknowledgement

Financial assistance rendered by Department of Science and Technology, Ministry of Science and Technology, New Delhi, vide Project No. SR/WOS-A/LS-109/2016(G), is gratefully acknowledged.

References

- Bharti, M. 2015. *Polleniopsis annamensis* Kurahashi, 1972 (Diptera: Calliphoridae) a new record from India, with a revised key to the known Indian Species. *Halteres*, 6: 63-65.
- Bharti, M. and Verves, Y.G. 2016. A new species of genus *Polleniopsis* from India (Diptera: Calliphoridae) with a key to the Indian Species. *Halteres*, 7: 1-4.
- Rognes, K. 1991. Blowflies (Diptera: Calliphoridae) of Fennoscandia and Denmark. *Fauna Entomologica Scandinavica* 24: 1-272.
- Rognes, K. 1997. Additions to the Swiss fauna of blowflies with an analysis of the systematic position of *Calliphora stylifera* (Pokorny 1889) including a description of the female (Diptera: Calliphoridae). *Mitteilungen der Schweizerischen Entomologischen Gesellschaft* 70: 63-76.
- Rognes, K. 1998. Calliphoridae, pp. 617-648, *In*: L. Papp and B. Darvas (eds.), *Contributions to the Manual of Palaearctic Diptera* (with special reference to flies of economic importance). Vol. 3. Higher Brachycera. Budapest: Science Herald. 880pp.
- Schumann, H. 1964. Revision der Gattung *Onesia* Robineau-Desvoidy, 1830 (Diptera: Calliphoridae). *Beitraege zur Entomologie* 14 (7-8): 915-938.
- Schumann, H. 1974. Bemerkungen zum Status der Gattungen *Onesia*, *Melinda* and *Bellardia* (Diptera: Calliphoridae). *Mitteilungen aus dem Zoologischen Museum in Berlin*. Berlin 49 [1973]:333-344.
- Schumann, H. 1986. Family Calliphoridae, pp. 11-59, *In*: Á Soós and L. Papp (eds.), *Catalogue of Palaearctic Diptera*. Vol. 12. Akadémiai Kiadó, Budapest. 265pp.
- Verves, Y.G. 2004. A Review of the Species of “*Onesia*” Generic Group (Diptera:Calliphoridae). Part 3. The species of Genus *Onesia* Robineau-Desvoidy, 1830. *Far Eastern Entomologist* 138: 1-19.
- Verves, Y.G. 2005. A catalogue of Oriental Calliphoridae (Diptera). *An International Journal of Dipterological Research* 16(4): 233-310.
- Verves, Y.G. and Khrokalo, L.A. 2006. 121. Family Calliphoridae. Key to the insects of Russian Far East 6(4): 15-60. Vladivostok [in Russian].
- Xue, W.Q. and Wang, M.F. (eds.) 2006. Calliphoridae, pp. 204 *In*: *Flies of the Qinghai-Xizang Plateau* (Insecta: Diptera) Science Press, Beijing, China.xvi + 336 pp.

Thrips (Insecta: Thysanoptera) fauna from the Dampa Tiger Reserve, Mizoram, India

Thang Johnson* & R. Varatharajan

Centre for Advanced Study in Life Sciences, Manipur University, Canchipur –795 003, India.

(Email: thangjohnson@gmail.com)

Abstract

The data from the Dampa Tiger Reserve (DTR) (23°20' to 23°47' N latitude and 92°15' to 92°30' E longitude) situated in the district of West Phaileng, Mizoram, NE India revealed the occurrence of 55 thrips species belonging to 3 families, 5 sub-families and 40 genera. All the fifty-five species with the exception of *Nagathrips crenulatus* were collected and recorded for the first time from the state of Mizoram. Among these, 28 species placed in 21 genera belong to the suborder Terebrantia while 27 species clubbed in 19 genera are tubuliferans. In terms of feeding habit and habitat, 17 species are foliage invaders, 15 are flower inhabiting anthophilous species, 12 are fungal spore feeding mycophagous forms, 6 are gall inducing cecidogenous thrips, 4 are of grass dwellers and one is aquatic.

Keywords: *Thrips, Thysanoptera, Mizoram, survey, habit, habitat.*

Received: 27 January 2018; Revised: 22 June 2018; Online: 12 September 2018.

Introduction

Thrips are minute insects belonging to the order Thysanoptera. They are characterized by the presence of protrusible bladder-like structure at the tarsal end, fringed wings, and a pre-pupal stage between the larval & pupal stages. Yet another unique character is the asymmetrical mouthparts with vestigial right mandible. Insects of this order exhibit an incredible diversity of feeding habits in that, they may be herbivorous, fungivorous, pollinivorous or predacious (Mound & Marullo, 1996; Mound, 2005). Some of the species serve as biological carriers of tospovirus affecting at least 1090 plant species of diverse families (Parella *et al.*, 2003). However, some species act as predators on other soft-bodied insect pests like aleyrodids, coccids, mites, etc. acting as bio-control agents and the anthophilous forms involve in pollination in the agro-ecosystem (Ananthakrishnan, 1969, 1982).

Taxonomic survey pertaining to thrips of the Indian subcontinent has been carried out by a number of scientists and the results of which have been documented by Ananthakrishnan & Sen (1980) and Bhatti (1990). A list comprising 309 terebrantian and 430 tubuliferan species collected from India has been provided by Tyagi & Kumar (2016)

and recently, an updated catalogue of 333 terebrantians by Rachana & Varatharajan (2017). With respect to thrips of NE India, which is one of the world's megadiversity hotspots, a classified checklist of nearly 200 thrips has been presented by Varatharajan (2005). Subsequently, thrips of Nagaland (Tarunkumar & Varatharajan, 2010), Itanagar Wildlife Sanctuary, Arunachal Pradesh (Shyam, *et al.*, 2012), Kaziranga National Park of Assam (Chingthangkomba & Varatharajan, 2013), and Keibul Lamjao National Park of Manipur (Nishikanta & Varatharajan, 2014) were documented. . The present paper provides an inventory of thrips collected from Dampa Tiger Reserve, Mizoram.

Materials and Methods

Study Area: The Dampa Tiger Reserve (approx. 500 km² area; 23°20' to 23°47' N latitude and 92°15' to 92°30' E longitude) lies in west Mizoram of north-eastern India, sharing an international border with Bangladesh. The altitude ranges from 250 to 1100 m above mean sea level (Raman *et al.*, 1998). The site falls under the category of moist deciduous forests in the lower altitudes and evergreen and semi-evergreen with natural

grassland at higher altitudes (Champion & Seth, 1968).

Field Survey & Sampling Methods:

Survey was undertaken after prior permission from the Forest department of Mizoram. During the study period (2014–16), periodical collections were made to cover most parts of the accessible areas. Different methods like random sampling, delayed counting, sweeping method, modified Tullgren method, etc. were followed to collect thrips from diverse habitats (Ananthakrishnan, 1984) and the extracted specimens were preserved in a standard collection fluid (10% Ethanol + Glacial Acetic acid in the ratio 9:1 with few drops of Triton-X) (Bhatti, 1997) for further processing in the laboratory.

Slide Preparation:

Permanent slides were prepared by following the protocol available at ThripsWiki (accessed on 14 December, 2015).

Thrips Identification & Cataloguing:

The prepared permanent slides were then identified using standard keys available in the specialized monographs and publications of Ananthakrishnan & Sen, 1980; Bhatti, 1980; Dang *et al.*, 2014; Mound & Minaei, 2007; Mound & Ng, 2009; Sen *et al.*, 1988; Palmer *et al.*, 1989; Varatharajan, 2005. The specimens were also compared with reference slides and some paratypes available in the Insect Museum of Manipur University. Some of the specimens were identified by Prof. L. A. Mound, CSIRO, Australia and Prof. J. S. Bhatti of Delhi University. Finally, validation was done with the help of ThripsWiki (accessed on 11 September, 2017), to facilitate diagnosis and accurate identification of the specimens.

Results & Discussion

The present study revealed the occurrence of 55 species belonging to 3 families, namely Merothripidae, Thripidae & Phlaeothripidae, and 5 sub-families viz., Dendrothripinae, Panchaetothripinae, Thripinae, Idolothripinae & Phlaeothripinae. The following systematic list provides details about the collected specimens.

I. SUBORDER TEREBRANTIA

IA. Family Merothripidae

Genus *Merothrips* Hood, 1912

1. *Merothrips indicus* Bhatti & Ananthakrishnan, 1975

Specimen studied: 2♀, Dampa Tiger Reserve; Mycophagous; ex. Dry twigs of Grass; Dt. 11.iii.2014;

Distribution: **India**– Kerala, Manipur, Nagaland, Tamil Nadu; **World**– China.

IB. Family Thripidae

Subfamily Dendrothripinae

Genus *Dendrothrips* Uzel, 1895

2. *Dendrothrips schimae* Kudo, 1989

Specimen studied: 6♀ & 4♂, Dampa Tiger Reserve; Phyllophilous; ex. Leaves of *Schima wallichii* (DC.) Korth. (Theaceae); Dt. 3.x.2014;

Distribution: **India**– Manipur, Nagaland; **World**– Nepal.

Subfamily Panchaetothripinae

Genus *Astrothrips* Karny, 1921

3. *Astrothrips tumiceps* Karny, 1923

Specimen studied: 5♀, Dampa Tiger Reserve; Phyllophilous; ex. Leaves of *Melia azaderarch* L. (Meliaceae); Dt. 24.xi.2015.

Distribution: **India**– Assam, Arunachal Pradesh, Delhi, Karnataka, Madhya Pradesh, Manipur, Punjab, Tamil Nadu, Uttar Pradesh, West Bengal; **World**– Indonesia, Philippines, northern Australia.

Genus *Helionothrips* Bagnall, 1932

4. *Helionothrips kadaliphilus* (Ramakrishna & Margabandhu, 1931)

Specimen studied: 8♀ & 4♂, Dampa Tiger Reserve; Phyllophilous; ex. Leaves of *Colocasia esculenta* (L.) Schott (Araceae); Dt. 25.ix.2014.

Distribution: **India**– Assam, Arunachal Pradesh, Kerala, Maharashtra, Manipur, Meghalaya, Nagaland, Tamil Nadu, West Bengal; **World**– New Guinea.

Genus *Heliothrips* Haliday, 1836

5. *Heliothrips haemorrhoidalis* (Bouche, 1833)

Specimen studied: 4♀ & 1♂, Dampa Tiger Reserve; Phyllophilous; ex. Leaves of *Ficus* sp. (Moraceae); Dt. 1.x.2016.

Distribution: **India**– Andamans, Arunachal Pradesh, Karnataka, Kerala, Maharashtra, Manipur, Meghalaya, Nagaland, Tamil Nadu; **World**– Australia, Germany, England, Finland, Sri Lanka, Suriname.

Genus *Monilothrips* Moulton, 1929

6. *Monilothrips kempi* Moulton, 1929

Specimen studied: 2♀, Dampa Tiger Reserve; Phyllophilous; ex. Fronds of *Dryopteris* sp. (Dryopteridaceae); Dt. 1.x.2016.

Distribution: **India**– Madhya Pradesh, Manipur, Nagaland, Tamil Nadu, Uttar Pradesh, West Bengal; **World**– China, North America, South Africa.

Genus *Panchaetothrips* Bagnall, 1912

7. *Panchaetothrips indicus* Bagnall, 1912

Specimen studied: 10♀ & 4♂, Dampa Tiger Reserve; Phyllophilous; ex. Leaves of *Curcuma longa* L. (Zingiberaceae); Dt. 18.iii.2015.

Distribution: **India**– Assam, Arunachal Pradesh, Bihar, Goa, Haryana, Kerala, Manipur, Nagaland, Tamil Nadu, Uttar Pradesh, West Bengal; **World**– Bangladesh, China, Thailand.

Genus *Phibalothrips* Hood, 1918

8. *Phibalothrips peringueyi* (Faure, 1925)

Specimen studied: 4♀, Dampa Tiger Reserve; Grass; ex. Inflorescence of *Paspalum orbiculare* G. Forst. (Poaceae); Dt. 24.ix.2016.

Distribution: **India**– Assam, Arunachal Pradesh, Delhi, Karnataka, Madhya Pradesh, Manipur, Meghalaya, Nagaland, Tamil Nadu, Uttar Pradesh, West Bengal; **World**– South Africa, Taiwan.

Genus *Rhipiphorothrips* Morgan, 1913

9. *Rhipiphorothrips cruentatus* Hood, 1919

Specimen studied: 6♀, Dampa Tiger Reserve; Phyllophilous; ex. Leaves of *Jatropha* sp. (Euphorbiaceae); Dt. 2.x.2016.

Distribution: **India**– Andaman Island, Assam, Delhi, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Punjab, Tamil Nadu, Uttar Pradesh, West Bengal; **World**– Afghanistan, Pakistan, Sri Lanka.

Genus *Selenothrips* Karny, 1911

10. *Selenothrips rubrocinctus* (Giard, 1901)

Specimen studied: 5♀, Dampa Tiger Reserve; Phyllophilous; ex. Leaves of *Quercus* sp. (Fagaceae); Dt. 25.ix.2014.

Distribution: **India**– Andaman Island, Assam, Arunachal Pradesh, Karnataka, Kerala, Manipur, Meghalaya, Nagaland, West Bengal; **World**– Bangladesh, Honduras, Mexico, Myanmar, Philippines, Sri Lanka, Taiwan, Thailand.

Subfamily Thripinae

Genus *Anaphothrips* Uzel, 1895

11. *Anaphothrips sudanensis* Trybom, 1911

Specimen studied: 10♀, Dampa Tiger Reserve; Grass; ex. Inflorescence of *Echinochloa* sp. (Poaceae); Dt. 28.ix.2014.

Distribution: **India**– Assam, Arunachal Pradesh, Delhi, Karnataka, Manipur, Meghalaya, Nagaland, Punjab, Sikkim, West Bengal; **World**– Philippines, Trinidad, Puerto Rico, Taiwan, New South Wales, Australia, South Africa, Egypt, Malabar, Indonesia, Sri Lanka.

Genus *Ayyaria* Karny, 1927

12. *Ayyaria chaetophora* Karny, 1926

Specimen studied: 5♀ & 1♂, Dampa Tiger Reserve; Anthophilous; ex. Flowers of *Sida* sp. (Malvaceae); Dt. 3.x.2014.

Distribution: **India** – Andhra Pradesh, Arunachal Pradesh, Assam, Delhi, Haryana, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Nagaland, Odisha, Tamil Nadu, Uttar Pradesh, West Bengal; **World**– Christmas Island (Indian Ocean), Taiwan, Japan, Philippines, Tahiti, Australia.

Genus *Bolacothrips* Uzel, 1895

13. *Bolacothrips indicus** (Ananthakrishnan, 1966)

Specimen studied: 4♀, Dampa Tiger Reserve; Grass; ex. Leaf sheaths of *Saccharum* sp. (Poaceae); Dt. 26.ix.2016. (* indicates endemic to India).

Distribution: **India** – Arunachal Pradesh, Gujarat, Kerala, Madhya Pradesh, Manipur, Nagaland, Tamil Nadu, West Bengal.

Genus *Dichromothrips* Priesner, 1932

14. *Dichromothrips nakahari** Mound, 1976

Specimen studied: 9♀, Dampa Tiger Reserve; Anthophilous; ex. Flowers of *Dendrobium* sp. (Orchidaceae); Dt. 18.iii.2015.

Distribution: **India**– Assam, Arunachal Pradesh, Meghalaya, Nagaland, West Bengal.

Genus *Megalurothrips* Bagnall, 1915

15. *Megalurothrips distalis* (Karny, 1913)

Specimen studied: 4♀, Dampa Tiger Reserve; Anthophilous; ex. Flowers of *Phaseolus vulgaris* L. (Fabaceae); Dt. 24.ix.2016.

Distribution: **India**– Andaman Island, Arunachal Pradesh, Assam, Meghalaya, Nagaland, Tamil Nadu, Tripura, Uttar Pradesh, West Bengal; **World**– China,

Fiji, Indonesia, Korea, Philippines, Sri Lanka.

16. *M. mucunae* (Priesner, 1938)

Specimen studied: 7♀, Dampa Tiger Reserve; Anthophilous; ex. Flowers of *Phaseolus vulgaris* L. (Fabaceae); Dt. 3.x.2014.

Distribution: **India**– Assam, Manipur; **World**– Fiji, Indonesia.

17. *M. peculiaris* (Bagnall, 1918)

Specimen studied: 4♀, Dampa Tiger Reserve; Anthophilous; ex. Flowers of *Phaseolus vulgaris* L. (Fabaceae); Dt. 24.ix.2016.

Distribution: **India**– Arunachal Pradesh, Assam, Bihar, Delhi, Karnataka, Manipur, Meghalaya, Nagaland, Punjab, Tamil Nadu, Uttar Pradesh; **World**– China.

Genus Microcephalothrips Bagnall, 1926

18. *Microcephalothrips abdominalis* (Crawford DL, 1910)

Specimen studied: 10♀, Dampa Tiger Reserve; Anthophilous; ex. Flowers of *Ageratum conyzoides* L. (Asteraceae); Dt. 12.iii.2014.

Distribution: **India**– Arunachal Pradesh, Assam, Delhi, Himachal Pradesh, Karnataka, Manipur, Meghalaya, Nagaland, Punjab, West Bengal; **World**– Korea, Iran, Sri Lanka, Philippines, Indonesia, Egypt, Guam, Australia, New Zealand, USA, Canada, Cuba, Argentina, Mexico.

Genus Organothrips Hood, 1940

19. *Organothrips indicus* Bhatti, 1974

Specimen studied: 9♀, Dampa Tiger Reserve; Aquatic; ex. Petiole of *Eichhornia crassipes* (Mart.) Solms (Pontederiaceae); Dt. 29.xii.2015.

Distribution: **India**– Arunachal Pradesh, Delhi, Maharashtra, Manipur, West Bengal; **World**– Australia, Bangladesh, Florida, Germany, Hong Kong, Thailand.

Genus Rhamphothrips Karny, 1913

20. *Rhamphothrips aureus* (Ananthakrishnan, 1954)

Specimen studied: 5♀, Dampa Tiger Reserve; Phyllophilous; ex. Leaves of *Sesbania* sp. (Leguminosae); Dt. 24.xii.2015.

Distribution: **India**– Arunachal Pradesh, Delhi, Maharashtra, Manipur, West Bengal; **World**– Australia, Bangladesh, Florida, Germany, Hong Kong, Thailand.

Genus Scirtothrips Shull, 1909

21. *Scirtothrips dorsalis* Hood, 1919

Specimen studied: 7♀, Dampa Tiger Reserve; Phyllophilous; ex. Leaves of *Mangifera indica* L. (Anacardiaceae); Dt. 20.iii.2015.

Distribution: **India**– Andhra Pradesh, Arunachal Pradesh, Assam, Delhi, Gujarat, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Nagaland, Odisha, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal; **World**– Bangladesh, Indonesia, Japan, Malaysia, Pakistan, South Africa.

Genus Stenchaetothrips Bagnall, 1926

22. *Stenchaetothrips biformis* (Bagnall, 1913)

Specimen studied: 8♀, Dampa Tiger Reserve; Grass; ex. Inflorescence of *Phragmites karka* (Retz.) Trin.ex. Steud. (Poaceae); Dt. 14.iii.2014.

Distribution: **India**– Arunachal Pradesh, Delhi, Chandigarh, Himachal Pradesh, Karnataka, Odisha, Madhya Pradesh, Manipur, Meghalaya, Sikkim, Tamil Nadu, Uttar Pradesh, West Bengal; **World**– Australia, Bangladesh, England, Indonesia, Romania; widespread in Asia.

Genus Thrips Linnaeus, 1758

23. *Thrips florum* Schmutz, 1913

Specimen studied: 8♀, Dampa Tiger Reserve; Anthophilous; ex. Flowers of *Amaranthus* sp. (Amaranthaceae); Dt. 25.ix.2014.

Distribution: **India**– Andaman Island, Arunachal Pradesh, Delhi, Karnataka, Manipur, Punjab; **World**– Australia, Brunei, Fiji, Hawaii, Java, Myanmar, Malaysia, New Guinea, Singapore, Sri Lanka, Tahiti, Thailand, Philippines.

24. *T. hawaiiensis* (Morgan, 1913)

Specimen studied: 10♀ & 2♂, Dampa Tiger Reserve; Anthophilous; ex. Flowers of *Mangifera indica* L. (Anacardiaceae); Dt. 18.iii.2015.

Distribution: Cosmopolitan.

25. *T. orientalis* (Bagnall, 1915)

Specimen studied: 8♀, Dampa Tiger Reserve; Anthophilous; ex. Flowers of *Lantana camara* L. (Verbenaceae); Dt. 15.iii.2014.

Distribution: **India**– Arunachal Pradesh, Assam, Delhi, Karnataka, Maharashtra, Manipur, Punjab, Tripura, Tamil Nadu,

Uttar Pradesh, West Bengal; Cosmopolitan; **World**– Australia, Florida, Hawaii, New Caledonia, Tanzania, Trinidad; widespread in Asian tropics.

26. *T. palmi* Karny, 1925

Specimen studied: 9♀, Dampa Tiger Reserve; Anthophilous; ex. Flowers of *Citrus* sp. (Rutaceae); Dt. 28.ix.2014.

Distribution: Cosmopolitan.

27. *T. tabaci* Lindeman, 1889

Specimen studied: 7♀, Dampa Tiger Reserve; Anthophilous; ex. Flowers of *Allium cepa* L. (Amaryllidaceae); Dt. 25.iii.2015.

Distribution: Cosmopolitan.

Genus *Tusothrips* Bhatti, 1967

28. *Tusothrips setiprivus* (Karny, 1926)

Specimen studied: 4♀, Dampa Tiger Reserve; Phyllophilous; ex. Leaves of *Amaranthus* sp. (Amaranthaceae); Dt. 25.ix.2014.

Distribution: **India**– Manipur, Tamil Nadu, West Bengal; **World**– Australia, Thailand.

II. SUBORDER TUBULIFERA

IIA. Family Phlaeothripidae Uzel, 1895

Subfamily Idolothripinae Bagnall, 1908

Genus *Elaphrothrips* Buffa, 1909

29. *Elaphrothrips curvipes* Priesner, 1929

Specimen studied: 5♀, Dampa Tiger Reserve; Mycophagous; ex. Dry twigs of *Mangifera indica* L. (Anacardiaceae); Dt. 2.x.2014.

Distribution: **India**– Arunachal Pradesh, Assam, Karnataka, Kerala, Maharashtra, Manipur, Meghalaya, Nagaland, Sikkim, Tamil Nadu, West Bengal; **World**– Bhutan, Germany, Indonesia, Laos, Malaysia, Thailand.

30. *E. denticollis* (Bagnall, 1909)

Specimen studied: 4♀, Dampa Tiger Reserve; Mycophagous; ex. Dry twigs of *Mangifera indica* L. (Anacardiaceae); Dt. 24.xii.2015.

Distribution: **India**– Arunachal Pradesh, Assam, Karnataka, Kerala, Meghalaya, Sikkim, Tamil Nadu, Tripura, West Bengal; **World**– China, Indonesia, Myanmar, Malaysia.

31. *E. insignis** Ananthakrishnan, 1973

Specimen studied: 5♀, Dampa Tiger Reserve; Mycophagous; ex. Dry twigs of

Mangifera indica L. (Anacardiaceae); Dt. 24.ix.2016.

Distribution: **India**– Arunachal Pradesh, Uttar Pradesh, Manipur, Nagaland, West Bengal.

Genus *Nesothrips* Kirkaldy, 1907

32. *Nesothrips brevicollis* (Bagnall, 1914)

Specimen studied: 3♀, Dampa Tiger Reserve; Mycophagous; ex. Dry twigs of *Mangifera indica* L. (Anacardiaceae); Dt. 2.x.2014.

Distribution: **India**– Assam, Kerala, Madhya Pradesh, Manipur; **World**– Fiji, Hawaii, Indonesia Japan, Mauritius, Philippines.

Subfamily Phlaeothripinae Uzel, 1895

Genus *Apelaunothrips* Karny, 1925

33. *Apelaunothrips* *madrasensis* (Ananthakrishnan, 1964)

Specimen studied: 3♀, Dampa Tiger Reserve; Mycophagous; ex. Litter of *Bambusa* sp. (Poaceae); Dt. 2.x.2016.

Distribution: **India**– Kerala, Manipur, Nagaland, Tamil Nadu; **World**– Japan, Java, Malaysia.

Genus *Baenothrips* Crawford, 1948

34. *Baenothrips asper* (Bournier, 1963)

Specimen studied: 2♀, Dampa Tiger Reserve; Mycophagous; ex. Litter of Grass; Dt. 12.iii.2014.

Distribution: **India**– Andaman, Andhra Pradesh, Arunachal Pradesh, Kerala, Manipur, Nagaland, Tamil Nadu; **World**– Angola, China.

Genus *Bamboosiella* Ananthakrishnan, 1957

35. *Bamboosiella nayari* (Ananthakrishnan, 1958)

Specimen studied: 4♀, Dampa Tiger Reserve; Mycophagous; ex. Litter of *Bambusa* sp. (Poaceae); Dt. 24.ix.2016.

Distribution: **India**– Arunachal Pradesh, Kerala, Manipur, West Bengal. **World**– China.

Genus *Dolichothrips* Karny, 1912

36. *Dolichothrips assimilis** Priesner & Seshadri, 1952

Specimen studied: 7♀, Dampa Tiger Reserve; Phyllophilous; ex. Leaves of *Quercus* sp. (Fagaceae); Dt. 25.xii.2015.

Distribution: **India**– Arunachal Pradesh, Nagaland, Tamil Nadu.

37. *D. indicus* (Hood, 1919)

- Specimen studied: 7♀, Dampa Tiger Reserve; Anthophilous; ex. Flowers of *Ailanthus* sp. (Simaroubaceae); Dt. 16.iii.2015.
Distribution: **India**— Assam, Delhi, Karnataka, Kerala, Manipur, Meghalaya, Nagaland, Tamil Nadu, West Bengal; **World**— Guam, Sri Lanka, Taiwan.
38. *D. montanus** Ananthakrishnan, 1964
 Specimen studied: 7♀, Dampa Tiger Reserve; Anthophilous; ex. Flowers of *Lantana camara* L. (Verbenaceae); Dt. 25.ix.2014.
Distribution: **India**— Arunachal Pradesh, Assam, Manipur, Nagaland, Tamil Nadu, West Bengal.
- Genus *Ecacanthothrips* Bagnall, 1909**
39. *Ecacanthothrips tibialis* (Ashmead, 1905)
 Specimen studied: 3♀, Dampa Tiger Reserve; Mycophagous; ex. Litter of *Bambusa* sp. (Poaceae); Dt. 22.ix.2016.
Distribution: **India**— Arunachal Pradesh, Assam, Karnataka, Kerala, Manipur, Meghalaya, Nagaland, Tripura, Tamil Nadu, Tripura, West Bengal. **World**— Australia, China, Indonesia, Japan, Malaysia, Philippines, Tanzania, Vietnam, New Zealand.
- Genus *Gigantothrips* Zimmermann, 1900**
40. *Gigantothrips elegans* Zimmermann, 1900
 Specimen studied: 5♀, Dampa Tiger Reserve; Phyllophilous; ex. Leaves of *Ficus* sp. (Moraceae); Dt. 19.iii.2015.
Distribution: **India**— Arunachal Pradesh, Assam, Bihar, Delhi, Karnataka, Manipur, Nagaland, Odisha, Punjab, Tamil Nadu; **World**— China, Indonesia, Japan, Philippines, Thailand.
41. *G. tibialis* Bagnall, 1921
 Specimen studied: 7♀, Dampa Tiger Reserve; Phyllophilous; ex. Leaves of *Ficus* sp. (Moraceae); Dt. 10.x.2016.
Distribution: **India**— Andaman, Arunachal Pradesh, Assam, Karnataka, Kerala, Manipur, Nagaland, Uttarakhand; **World**— China, Sri Lanka.
- Genus *Gynaikothrips* Zimmermann, 1900**
42. *Gynaikothrips bengalensis** Ananthakrishnan, 1973
 Specimen studied: 10♀, Dampa Tiger Reserve; Cecidogenous; ex. Leaf galls of *Pongamia* sp. (Fabaceae); Dt. 24.iii.2015.
- Distribution: **India**— Arunachal Pradesh, Assam, Karnataka, Manipur, Nagaland, Tripura, West Bengal.
43. *G. uzeli* (Zimmermann, 1900)
 Specimen studied: 8♀, Dampa Tiger Reserve; Phyllophilous; ex. Leaves of *Ficus curtipes* (Corner, 1960) (Moraceae); Dt. 20.iii.2015.
Distribution: Cosmopolitan.
- Genus *Haplothrips* Amyot & Serville, 1843**
44. *Haplothrips (Haplothrips) gowdeyi* (Franklin, 1908)
 Specimen studied: 10♀ & 2♂, Dampa Tiger Reserve; Anthophilous; ex. Flowers of *Leucaena leucocephala* (Lam.) de Wit (Fabaceae); Dt. 23.x.2015.
Distribution: Cosmopolitan.
45. *Haplothrips (Haplothrips) tenuipennis* Bagnall, 1918
 Specimen studied: 6♀ & 1♂, Dampa Tiger Reserve; Anthophilous; ex. Flowers of *Gomphrena globosa* L. (Amaranthaceae); Dt. 28.xii.2015.
Distribution: Cosmopolitan.
- Genus *Karnyothrips* Watson, 1923**
46. *Karnyothrips melaleucus* (Bagnall, 1911)
 Specimen studied: 3♀, Dampa Tiger Reserve; Mycophagous; ex. Mixed leaf litter; Dt. 25.ix.2016.
Distribution: **India**— Andaman Island, Arunachal Pradesh, Assam, Karnataka, Kerala, Manipur, Meghalaya, Nagaland, Tamil Nadu, West Bengal; **World**— China, Denmark, Indonesia, Vietnam.
- Genus *Leeuwenia* Karny, 1912**
47. *Leeuwenia ananthakrishnani** Varatharajan & Sen, 2000
 Specimen studied: 7♀, Dampa Tiger Reserve; Phyllophilous; ex. Leaves of *Quercus* sp. (Fagaceae); Dt. 22.ix.2016.
Distribution: **India**— Assam, Manipur, Nagaland.
- Genus *Liothrips* Uzel, 1895**
48. *Liothrips (Liothrips) aberrans** Muraleedharan & Sen, 1978
 Specimen studied: 4♀, Dampa Tiger Reserve; Cecidogenous; ex. Leaf galls of *Bixa orellana* Linn. (Bixaceae); Dt. 10.x.2016.
Distribution: **India**— Arunachal Pradesh, Sikkim, Manipur, Nagaland, West Bengal.
49. *Liothrips (Liothrips) himalayanus** Ananthakrishnan & Jagadish, 1970

Specimen studied: 3♀, Dampa Tiger Reserve; Cecidicolous; ex. Leaf galls of *Quercus* sp. (Fagaceae); Dt. 24.ix.2016.

Distribution: **India**– Arunachal Pradesh, Assam, Manipur, Meghalaya, Nagaland, West Bengal.

Genus *Mesothrips* Zimmermann, 1900

50. *Mesothrips jordani* Zimmermann, 1900

Specimen studied: 4♀, Dampa Tiger Reserve; Cecidicolous; ex. Leaf galls of *Quercus* sp. (Fagaceae); Dt. 3.x.2016.

Distribution: **India**– Andaman Island, Arunachal Pradesh, Karnataka, Manipur, Tamil Nadu, Tripura, West Bengal; **World**– Australia, China, Indonesia, Japan.

Genus *Nagathrips* (Varatharajan & Singh, 2000)

51. *Nagathrips crenulatus (Varatharajan & Singh, 2000)**

Specimen studied: 7♀, Dampa Tiger Reserve; Phyllophilous; ex. Leaves of *Mallotus* sp. (Euphorbiaceae); Dt. 12.iii.2014.

Distribution: **India**– Nagaland.

Genus *Ocnothrips* Ananthakrishnan, 1969

52. *Ocnothrips indicus Ananthakrishnan, 1969**

Specimen studied: 3♀, Dampa Tiger Reserve; Cecidicolous; ex. Leaf galls of *Piper* sp. (Piperaceae); Dt. 25.ix.2016.

Distribution: **India**– Arunachal Pradesh, Kerala, Manipur, Nagaland.

Genus *Thlibothrips* Priesner, 1952

53. *Thlibothrips manipurensis
Muraleedharan, 1982**

Specimen studied: 4♀, Dampa Tiger Reserve; Cecidicolous; ex. Leaf galls of *Litsea monopetala* (Roxb.) Pers. (Lauraceae); Dt. 2.x.2016.

Distribution: **India** – Manipur, Nagaland.

Genus *Urothrips* Bagnall, 1909

54. *Urothrips tarai (Stannard, 1970)**

Specimen studied: 2♀, Dampa Tiger Reserve; Mycophagous; ex. Leaf litter of *Quercus* sp. (Fagaceae); Dt. 24.iii.2015.

Distribution: **India**– Arunachal Pradesh, Manipur, Nagaland, Uttar Pradesh.

Genus *Xylaplothrips* Priesner, 1928

55. *Xylaplothrips ligs* Ananthakrishnan & Jagadish, 1971

Specimen studied: 3♀, Dampa Tiger Reserve; Mycophagous; ex. Mixed leaf litter; Dt. 3.x.2014.

Distribution: **India**– Andhra Pradesh, Delhi, Karnataka, Manipur, Tamil Nadu.

* indicates species endemic to India.

Conclusions

The survey carried out at the Dampa Tiger Reserve (DTR) revealed the occurrence of 55 species of thrips belonging to 40 genera in five subfamilies and three families under two sub-orders. The families Merothripidae and Thripidae under the suborder Terebrantia were represented by a single species in the former and 27 species in the latter, while 27 species in the family Phlaeothripidae were collected under the suborder Tubulifera. The genus *Thrips* had the maximum of 5 species, while the genera *Elaphrothrips*, *Dolicothrips*, and *Megalurothrips* had 3 species each, and the rest with either 1 or 2 species. 2 terebrantians and 11 tubuliferans marked with an asterisk (*) are endemic to India. Foliage inhabiting thrips had the highest number of 17 species, followed by 15 species of flower inhabiting forms. The species, namely *Rhipiphorothrips cruentatus*, *Scirtothrips dorsalis*, *Stenchaetothrips biformis*, *Thrips hawaiiensis*, *T. palmi*, *T. palmi* have been reported to be serious pests of crops. A single aquatic form (*Organothrips indicus*) was also recorded occurring on the weed *Eichhornia crassipes*. From the total collected specimens, majority of them are phytophagous while about 24% are spore and mycelia feeders. As many as 33 different plant species from 24 families were screened for thrips during the survey.

Acknowledgements

The authors are highly indebted to the Head, Department of Life Sciences, Manipur University for the encouragement and facilities. Thanks are due to the forest officials for granting permission to collect specimens from the reserve areas. One of the authors, Mr. Th. Johnson would like to thank UGC (New Delhi) for providing fellowship under the CSIR UGC JRF scheme.

References

- Ananthakrishnan, T.N. 1969. Indian Thysanoptera. C.S.I.R. Zoological Monograph 1: 1-171.
Ananthakrishnan, T.N. 1982. Thrips and Pollination Biology. Current Science 51(4): 168-172.

- Ananthakrishnan, T.N. 1984. Bioecology of thrips. USA: Indira Publishing House. 205 pp.
- Ananthakrishnan, T.N. and Sen, S. 1980. Taxonomy of Indian Thysanoptera. Handbook series No.1 .Zoological Survey of India. 234 pp.
- Bhatti, J.S. 1980. Species of the genus Thrips from India (Thysanoptera). Systematic Entomology 5: 109-166.
- Bhatti, J.S. 1990. Catalogue of insects of the Order Terebrantia from Indian subregion. Zoology 2(4): 205-352.
- Bhatti, J.S. 1997. Thysanoptera. Fauna of Delhi, State Fauna Series, Zoological Survey of India: Dehradun 6: 291-332.
- Champion, H.G. and Seth, S.K. 1968. A Revised Survey of the Forest Types of India. Manager of Publication, Government of India, Delhi.
- Chingthangkomba S.H. and Varatharajan, R. 2013. Thrips (Insecta: Thysanoptera) fauna of Kaziranga National Park, Assam. Current Science 105(10): 1219-1223.
- Dang, L.H., Mound, L.A. and Qiao, G.X. 2014. Conspectus of the Phlaeothripinae genera from China and Southeast Asia (Thysanoptera, Phlaeothripidae). Zootaxa 3807(1): 001–082.
- Mound, L.A. 2005. Thysanoptera: diversity and interactions. Annual Review of Entomology 50: 247-269.
- Mound, L.A. and Marullo, R. 1996. The thrips of Central and South America: an introduction (Insecta: Arthropoda) 6: 1-487.
- Mound, L.A. and Minaei, K. 2007. Australian thrips of the Haplothrips lineage (Insecta: Thysanoptera). Journal of Natural History 41(45-48): 2919-2978.
- Mound, L.A. and Ng. Y.F. 2009. An illustrated key to the genera of Thripinae (Thysanoptera) from South East Asia. Zootaxa 2265: 27-47.
- Nishikanta S.K. and Varatharajan, R. 2014. Thysanoptera (Insecta) Fauna of Keibul Lamjao National Park, Manipur.NE India. Journal of the Bombay Natural History Society 111(1): 19-28.
- Palmer, J.M., Mound, L.A. and du Heaume, G.J. 1989. CIE guides to insects of importance to man. 2. Thysanoptera. Wallingford: CAB Int. 73 pp.
- Parrella, G., Gognalons, P., Gebre-Selassie, K. and Marchous, G. 2003. An update of the host range of tomato spotted wilt virus. Journal of Plant Pathology 85: 227-264.
- Rachana, R.R. and Varatharajan, R. 2017. Checklist of Terebrantian thrips (Insecta: Thysanoptera) recorded from India. Journal of Threatened Taxa 9(1): 9748 – 9755.
- Raman T.R.S., Rawat G.S. and Johnsingh A. J.T. 1998. Recovery of tropical rainforest avifauna in relation to vegetation succession following shifting cultivation in Mizoram, northeast India. Journal of Applied Ecology 35: 214–231.
- Sen S., Pramanik, N.K. and Sengupta, C.K. 1988. Thysanoptera fauna of North Eastern India. Records of Zoological Survey of India, Occasional paper, No. 100: 1-123.
- Shyam, M., Varatharajan, R., Tarunkumar S.O. and Chakravorty, J. 2012. Thysanoptera Fauna of the Itanagar Wildlife Sanctuary, (Arunachal Pradesh). Record of the Zoological Survey of India 112(3): 35-43.
- Tarunkumar S.O. and Varatharajan, R. 2010. Comparative study on the diversity of Thysanoptera in monoculture and natural forests of Nagaland. Indian Journal of Entomology 72(3):223-227.
- ThripsWiki. 2015 & 2017. Thrips Wiki—providing information on the World thrips. Accessed online at http://thrips.info/wiki/Main_Page [accessed on 14 December, 2015 & 11 September, 2017].
- Tyagi, K. and Kumar, V. 2016. Thrips (Insecta: Thysanoptera) of India – An Updated Checklist. Halteres 7: 64-98.
- Varatharajan, R. 2005. Faunistic Diversity of Thrips (Thysanoptera) of North Eastern India. Silver Jubilee Publication of Manipur University.73 pp.

A New Latindiine Cockroach, *Gapudipentax guiting* gen. et sp. n. (Blattodea: Corydiidae: Latindiinae) from the Philippines

Cristian C. Lucañas

*Museum of Natural History, University of the Philippines Los Baños, Los Baños, Laguna,
Philippines.*

(Email: cclucanas@up.edu.ph)

Abstract

A unique species, *Gapudipentax guiting* Lucañas gen. et sp. n. (Blattodea: Corydiidae: Latindiinae), is described from Sibuyan Island, Philippines. It differs from other genera in Latindiinae by its pentagonal pronotum, brachyptery in males and the absence in venation of the male tegmina. The species would be the fifth Corydiidae recorded from the country and the first from Sibuyan Island, Romblon. A brief discussion on species composition of Latindiinae is provided.

Keywords: *brachyptery, dimorphism, new genus, new species, Sibuyan Island.*

Received: 1 July 2018; Revised: 12 September 2018; Online: 14 September 2018.

Introduction

Qui *et al.* (2016) summarized the problems in the classification of the subfamily Latindiinae and the need to revise the subfamily. Currently it consists of three genera, *Latindia* Stal, *Buboblatta* Hebard and *Sinolatindia* Qui *et al.* (Beccaloni, 2014), although several other genera have been previously placed here (Princis, 1963).

In the Philippines, only four species of Corydiidae are so far recorded, each from four different subfamilies (Beccaloni, 2014). With the exclusion of *Homopteroidea* Shelford from this subfamily (Roth, 1995, 2003; Beccaloni, 2014), no Latindiinae species has been recorded in the Philippines. Here, a new genus and species of Latindiinae cockroach from the Sibuyan Island, Philippines is described.

Materials and Methods

Collected specimens were preserved in 95% ethyl alcohol, and slide mounted using Canada Balsam. Male specimens were cold macerated by soaking in 10% aqueous Potassium Hydroxide (KOH) solution for 24 hours. They were then washed in distilled water to remove unwanted undissolved internal contents, and then with alcohol series and

anhydrous clove oil to remove excess water. Finally, they were mounted on microscope slides using Canada Balsam.

Illustrations were made by tracings of printed photomicrographs of clear slide-mounted specimens. The degree of sclerotization and pigmentation was made through line thickness and by stippling. The following measurements were obtained:

TL (Total length): the length from the tip of the vertex up to the tip of the subgenital plate;

Pn: Pronotum length \times width along the longest axis;

Tg: Tegmina length along the longest axis.

Standard deviations for each measurement were also noted. Terminologies used for male genitalia follow Klass (1977), and Roth (2003) for other characters. All specimens were deposited at the Entomological Collections of the UPLB-MNH, Philippines.

Taxonomy

Family Corydiidae Saussure 1864

Subfamily Latindiinae Handlirsch 1925

Genus *Gapudipentax* Lucañas gen. n.

[urn:lsid:zoobank.org:act:EE6BA5DD-F01F-4BA5-9D9E-1A72A61FDB55](https://zoobank.org/act:EE6BA5DD-F01F-4BA5-9D9E-1A72A61FDB55)

Type species: *Gapudipentax guiting* Lucañas sp. n. by monotypy.

Etymology: a combination of two words: “*Gapud*”, a patronym for the late Dr. Victor P. Gapud, in honor of his contributions to the advancement of insect systematics in the Philippines; + “*pentax*”, in reference to its pentagonal pronotum.

Diagnosis: Sexual dimorphism distinct (Figure 1A-B). *Male*: Vertex exposed, truncate. Ocelli absent (Fig. 1C). Pronotum pentagonal with rounded edges, finely pubescent, without Y-shaped sulcation. Forefemora type C, without apical spine (Fig. 1D). Hind basitarsomere distinctly longer than succeeding tarsomere combined; Pulvilli absent on all tarsomeres, ventral side of tarsomere covered with numerous setae. Tarsal claws serrated, symmetrical (Fig. 1E); Arolia well-developed. Tegmina subquadrate, reaching only up to the middle of second abdominal tergite, barely overlapping each other, slightly rounded hind margin (Fig. 1F). Supra-anal plate trapezoidal, with large hyaline macula (Fig. 1G). Subgenital plate entire, symmetrical; style simple, similar (Fig. 1H). *Female*: Same with male, except tegmina and wings fully developed, extending beyond the tip of the abdomen (Fig. 1B). Tegmina only with subcosta and posterior cubital vein distinct. Venation obscured due to damage incurred during preservation, (distinct R and M veins visible in Figure 1B). Supra-anal plate subtriangular, posterior margin with slight mesal indentation. Subgenital plate triangular with medial slit (Fig. 1I).

The genus resembles the Mainland Asian genus *Sinolatindia* Qui *et al.* 2016, in terms of exposed vertex, ocelli absent, absence of Y-shaped sulcation in the pronotum, forefemora type C without terminal spine, tarsal claws serrated, supraanal plate with medial non-setose macula, and elongate, apically twisted L3. On the other hand, it differs from it by the pentagonal pronotum, tegmina and wings reduced in male but well developed in females (well-developed in males, unknown in females of *Sinolatindia*), arolia well-developed (absent in *Sinolatindia*), subgenital plate symmetrical (weakly asymmetrical in *Sinolatindia*), and the

left and right phallomere of the genitalia distinct (separation indistinct in *Sinolatindia*).

Despite morphological similarity with *Sinolatindia*, the internal male genitalia of *Gapudipentax* is much closer to the Australian *Austropolyphaga* Mackerras, 1968. Furthermore, it also resembles *Austropolyphaga* in terms of vertex exposed, ocelli absent, Y-sulcation in the pronotum absent, forefemur Type C without terminal spine, tarsi slender covered with minute spines, arolia well-developed and the genitalia with distinct left and right phallomeres, L3 elongate and hook-like; it differs by pentagonal pronotum, tegmina and wings reduced in male but well developed in females (well-developed in males, absent in females of *Austropolyphaga*), tarsal claws serrated (simple in *Austropolyphaga*), supraanal plate with medial non-setose macula (absent in *Austropolyphaga*), subgenital plate symmetrical.

Known distribution: Philippines.

***Gapudipentax guiting* Lucañas sp. n.**

[urn:lsid:zoobank.org:act:F4FD981F-081C-4383-9229-1F228A7A2146](https://zoobank.org/act:F4FD981F-081C-4383-9229-1F228A7A2146)

Diagnosis: (same as generic diagnosis).

Description: *Size* (mm): Male: TL: 5.04; Pn: 1.30 x 1.53; Tg: 1.90. Female: TL: 6.00; Pn: 1.33 x 1.60; Tg: 4.45.

Male (Fig. 1A): Light brown throughout. Brachypterous. Head triangular (Fig. 1C). Vertex greatly exposed, nearly straight. Interocular distance greater than interantennal distance. First 13 antennomeres short, succeeding tarsomeres elongate. Third segment of maxillary palp longer, fifth segment bulbous. Pronotum pentagonal with rounded edges, finely pubescent, without Y-shaped medial sulcation. Forefemora type C, without terminal spine (Fig. 1D). Hind basitarsomere distinctly longer than succeeding tarsomere combined. Pulvilli absent, ventral side of tarsomeres covered with numerous setae. Tarsal claws serrated, symmetrical (Fig. 1E). Arolia well-developed. Tegmina subquadrate, reaching only up to the middle of second abdominal tergite, barely overlapping each other, slightly rounded hind

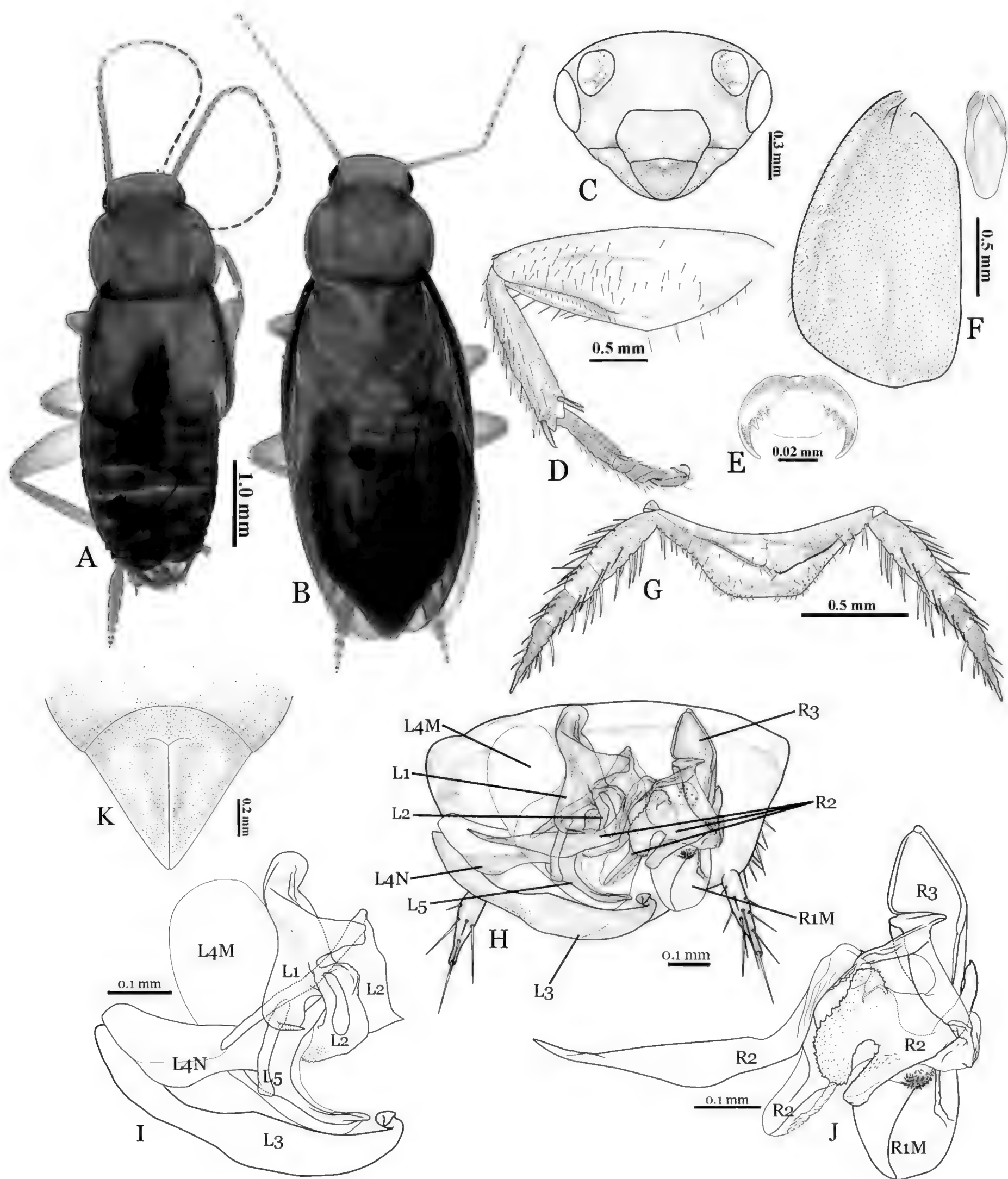


Figure 1. *Gapudipentax guiting* Lucañas gen. et sp. n.: Habitus (A) Male and (B) female; (C) head; (D) prothoracic leg; (E) tarsal claw; (F) Tegmina and hind wing; (G) male supra-anal plate; (H) male subgenital plate and genitalia, (I) left phallomere, (J) right phallomere; (K) female subgenital plate.

margin (Fig. 1F); venation indistinct, covered by setae. Hindwing reduced, venation indistinct (Fig. 1F). Abdominal tergites unspecialized. Supra-anal plate trapezoidal, with large hyaline macula (Fig. 1G). Subgenital plate symmetrical. Interstyler margin entire; style simple, similar. Male genitalia (Fig. 1G): L3 basally narrow, medially broad, hook twisted apically. R3 apically acute. R2 bifid, covered with barb-like structures.

Female (Fig. 1B): Similar with male except slightly larger and macropterous. Tegmina hyaline, with distinct subcosta and posterior cubital vein. Hind wings well developed, (unfortunately the tegmina and wings have been damaged during slide mounting and cannot be described further) distinct R and M veins visible in Figure 2B. Supra-anal plate subtriangular, posterior margin with slight mesal indentation. Subgenital plate triangular with medial slit (Fig. 1I).

Material examined

Holotype: 1 male, Philippines: Sibuyan Island, Mount Guiting-guiting National Park 10.xii.2016 (CCLucañas/DEMGGeneral, UPLBMNH BLA-00693♂, mounted on slide)

Paratypes: 1 female, 1 nymph same data as holotype (CCLucañas/DEMGGeneral, UPLBMNH BLA-00694♀, mounted on slide; BLA-00695 nymph).

Distribution: Philippines: Sibuyan Island.

Etymology: The specific epithet is derived from Mt. Guiting-guiting where the species was collected; and from “*guiting*” a local term which means teeth, referring to the spikes on the tarsal claws.

Ecology: The species was found under the sloughing bark of an unidentified dead tree. Their flat bodies allow them to hide along the crevices between the bark and sapwood and they were fast enough to hide among the crevices every time a piece of bark is peeled off. Several adult females and nymphs were observed along with a single male, which may suggest a subsocial behavior.

Aside from *G. gutting*, other organisms found under the bark of the dead tree included

scorpions, pseudoscorpions and some flat crab-like assassin bugs (Reduviidae), which may prey upon *G. gutting*.

Remarks: The aberrant sexual dimorphism of this species is interesting. This is the first report of tegmina and wing reduction due to sexual dimorphism being more expressed in males than in female cockroaches. Additional specimens may be needed to examine the extent of wing polymorphism even within the same sex. It is possible that females retained their fully developed wings in order to search for a more specialized habitat, like sloughing barks of trees, to deposit its ootheca. Additional observations are needed to confirm this hypothesis.

Notes on species composition of Latindiinae

The subfamily Latindiinae was established by Handlirsch (1925) to contain the minute, delicate winged *Latindia* Stal. Brues and Melander (1932) have raised it to the family level but Grandcolas (1996) and Roth (2003) retained it as a subfamily under Corydiidae (syn. Polyphagidae). Princis (1963) listed twelve genera: *Latindia* Stal, *Paralatindia* Saussure, *Ipisoma* Bolivar, *Ctenoneura* Hanitsch, *Compsodes* Hebard, *Homopteroidea* Shelford, *Melestora* Stal, *Bucolion* Rehn, *Biolleya* Saussure, *Buboblatta* Hebard, *Ipoblatta* Karny and *Stenoblatta* Walker under this subfamily. Roth (1971, 2003) moved *Biolleya* and *Stenoblatta* in Blaberidae: Panchlorinae and Blaberinae, respectively. Meanwhile Estrada-Alvarez and Guadarrama (2013) moved *Myrmecoblatta* Mann to Latindiinae. Beccaloni (2014) lists only *Latindia*, *Buboblatta* and the recently described *Sinolatindia* under Latindiinae. Here a new genus, *Gapudipentax* is described and placed in Latindiinae. Meanwhile, recent molecule-based phylogenetic studies, suggests close relationship between *Latindia* and *Paralatindia* (Wang *et al.*, 2017), and that Latindiinae is sister clade to Nocticolidae (Djernaes *et al.*, 2015; Wang *et al.*, 2017; Legendre *et al.*, 2015) and thus requires some change in taxonomic rank.

Unfortunately, the male genitalia of *Latindia* had not been fully described, inhibiting the identification of true relationships among the known genera. So far, among the listed genera,

only the male genitalia of *Ctenoneura*, *Homopteroidea*, *Sinolatindia* and *Gapudipentax* have been described in detail (Roth, 1995; Qui *et al.*, 2016, 2017). The male genitalia of *Ctenoneura* lacks a distinct hook-like sclerite (Qui *et al.*, 2017) indicating that it doesn't belong in this subfamily or any other established subfamily under Corydiidae. Meanwhile, all *Homopteroidea*, except *H. abberans* (Hanitsch), have rather complicated male genitalia with an indistinct hook-like sclerite and no particular separation between the left and right phallomeres (Roth, 1995). The genitalia of *Buboblatta* was illustrated in caudal view by Grandcolas (1996) revealing distinct sclerite of left and right phallomere, although it is unclear whether L3 is elongate and hook-like. Meanwhile, only the hook-like sclerite (L3) of the left phallomere had been described for species of *Compsodes* and *Myrmecoblatta* (Gutierrez, 2012; Estrada-Alvarez & Guadarrama, 2013), which are similar to *Sinolatindia*, *Gapudipentax* and *Austropolyphaga*.

Acknowledgements

The author wishes to extend his gratitude to the UPLB Museum of Natural History and its staff, particularly Mr. Jeremy Carlo B. Naredo and Mr. Orlando L. Eusebio for allowing him to access and examine the specimen; the Cave Ecology Laboratory, IBS for the use of laboratory space and equipment; Mr. Dave General for his help on collecting this particular species; Dr. Aimee Lynn B. Dupo for the use of camera that generated images of cockroaches, for providing support, and allowing the author to join their collection trips; Mt. Guiting-guiting Protected Area Superintendent, Mr. Malvin Lucero, and staff for the permit and accommodation during the sampling period; Mr. Dominic Evangelista for his invaluable comments on the manuscript; and Dr. Ireneo L. Lit, Jr. for his invaluable comments, suggestions and support for the advancement of Philippine systematics.

References

Beccaloni, G.W. 2014. *Cockroach Species File Online*. Version 5.0/5.0. World Wide Web electronic publication. <[http://Cockroach.](http://Cockroach.SpeciesFile.org)

[SpeciesFile.org](http://Cockroach.SpeciesFile.org)> [accessed 10 December 2017].

- Brues, C.T.T. and Melander, A.L. 1932. Classification of insects. A key to known families of insects and other terrestrial arthropods. Bulletin of the Museum of Comparative Zoology at Harvard College 73: 672.
- Djarnæs, M., Klass, K.D. and Eggleton, P. 2015. Identifying possible sister groups of Cryptocercidae + Isoptera: A combined molecular and morphological phylogeny of Dictyoptera. Molecular Phylogeny and Evolution 84: 284-303.
- Estrada-Alvarez, J.C. and Guadarrama, R.C. 2013. A new species of *Myrmecoblatta* Mann 1914 (Blattaria: Polyphagidae: Latindiinae) from Mexico. Boletín de la Sociedad Entomológica Aragonesa 52: 93-95.
- Grandcolas, P. 1996. The phylogeny of cockroach families: a cladistic appraisal of morpho-anatomical data. Canadian Journal of Zoology 74: 508-527.
- Gutierrez, E. 2012. Especie nueva del genero de cucarachas *Compsodes* (Dityoptera, Blattaria, Corydiidae) para la Republica Dominicana. Solenodon 10: 52-62.
- Handlirsch. 1925. Geschichte, Literatur, Technik, Palaontologie, Phylogenie und Systematik der Insekten. In: C. Schroder (ed.) Handbuch der Entomologie. Band III. Gustav Fischer, Jena, 1201pp.
- Klass, K.D. 1997. The external male genitalia and the phylogeny of Blattaria and Mantodea. Bonner Zoologische Monographien 42: 1-134
- Legendre, F., Nel, A., Svenson, G.J., Robillard, T., Pellens, R. and Grandcolas, P. 2015. Phylogeny of Dictyoptera: Dating the Origin of Cockroaches, Praying Mantises and Termites with Molecular Data and Controlled Fossil Evidence. PLoS ONE 10(7): e0130127. doi: 10.1371/journal.pone.0130127
- Mackerras, J. 1968. Polyphagidae (Blattodea) from Eastern Australia. Journal of the Australian Entomological Society 7:147-154.
- Princis, K. 1963. Blattariae: Suborde Polyphagoidea. Fam.: Homeogamiidae,

- Euthyrrhaphidae, Latindiidae, Anacomp-sidae, Atticolidae, Attaphilidae; Subordo Blaberoidea: Fam.: Blaberidae. *In*: M. Beier (ed.) Orthopterorum Catalogus Pars. 4. Uitgeverij Dr. W. Junk's Gravenhage, 77-172.
- Qui, L., Che, Y., and Wang, Z. 2016. *Sinolatindia petila* gen. n. and sp. n. from China (Blattodea, Corydiidae, Latindiinae). Zookeys 596: 27-38.
- Qui, L., Che, Y. and Wang, Z. 2017. Contribution to the cockroach genus *Ctenoneura* Hanitsch 1925 (Blattodea: Corydioidea: Corydiidae) with descriptions of seven new species from China. Zootaxa 4237(2): 265-299.
- Roth, L.M. 1971. The Male Genitalia of Blattaria VIII. *Panchlora*, *Anchoblatta*, *Biolleya*, *Pelloblatta*, and *Aghroblatta* (Blaberidae: Panchlorinae). Psyche 78(4): 296-305.
- Roth, L.M. 1995. Revision of the cockroach genus *Homopteroidea* Shelford (Blattaria, Polyphagidae). Tijdschrift voor Entomologie 138: 103-116.
- Roth, L.M. 2003. Systematics and Phylogeny of cockroaches (Dictyoptera: Blattaria). Oriental Insects 37: 1-186.
- Wang, Z., Shi, Y., Qui, Z., Che, Y., and Lo, N. 2017. Reconstructing the phylogeny of Blattodea: robust support for interfamilial relationships and major clades. Nature Scientific Reports 7(3903): 1-8.

Odontomachus ferminae, a new Philippine species of the *infandus* species group (Hymenoptera: Formicidae)

David Emmanuel M. General

University of the Philippines Los Baños Museum of Natural History, College, Los Baños, Laguna 4031, Philippines.

(Email: dmgeneral@up.edu.ph)

Abstract

Odontomachus ferminae sp. n., new species of the *infandus* species-group, is described based on the worker and alate female. A modification of the key to the *infandus* species-group is provided to include this new species.

Keywords: *Odontomachus*, *Formicidae*, *Mt. Guiting-guiting*, new species.

Received: 10 July 2018; Revised: 18 September 2018; Online: 24 September 2018.

Introduction

Ants of the genus *Odontomachus* Latreille, 1804 are spectacular members of the insect fauna of tropical forests. These large ants possess long narrow bodies and long legs. They forage on the forest floor with linear mandibles opened 180 degrees and perpendicular to the axis of the body.

The species diversity of *Odontomachus* ants in the Philippines is remarkably high, with 11 species out of 71 valid species (Bolton 2018). Sorger and Zettel (2011) recognized 11 species from the Philippines, including 3 species that they described[#]. They also included 2 morphospecies that they declined to name, bringing the number to 13 distinct forms. Only New Guinea, with 17 species, and Brazil, with 15 species, have more species than the Philippines (AntWiki 2018).

One of the uses of a generic revision, even of a single country, is the discovery of new species not treated in the revision. Specimens

that do not key out well are quite likely to be new species or at least new distributional records of species known from elsewhere.

It is interesting that Sorger and Zettel (2011) sampled the *Odontomachus* ants from Sibuyan Island but were unable to find the subject of this paper.

Materials and Methods

Measurements (in millimetres), arranged sequentially from anterior to posterior, and acronyms follow Sorger and Zettel (2011) to facilitate comparison with the species treated therein.

- | | |
|-----|---|
| MdL | Mandible length, maximum length of mandible from insertion to apex, measured in full face view. |
| HL | Head length, maximum length of head capsule, excluding mandibles, from anterior-most point of clypeal margin to posterior-most point of head capsule, measured in full face view. |
| HW | Maximum head width, including eyes when they exceed the lateral margin of the head, measured in full face view. |
| SL | Scape length, maximum length of scape, excluding basal neck and condyle, measured at the appropriate angle such |

[#]General and Alpert (2012) provided a slightly different list of 11 species that included *O. papuanus* Emery, 1887 and *O. saevissimus* F. Smith, 1858 which Sorger and Zettel (2011) had argued were cases of misidentification. It was not clear whether Sorger and Zettel examined the Philippine specimens at the Museum of Comparative Zoology, Harvard University that are referred to these species.

- that the scape is positioned perpendicular to the viewer.
- ML Mesosomal length measured from anterior edge of the pronotum (excluding the collar) to posterior edge of propodeal lobe.
- PnW Maximum width of pronotum, measured in dorsal view.
- PtH Petiole height, maximum height of petiole from bottom margin to petiole apex, measured in lateral view.
- PtL Petiole length, maximum length along the dorsal margin of petiole from anterior denticle to apex, measured in lateral view.
- PtW Petiole width, maximum width of petiole, measured in dorsal view.
- GL Gaster length, maximum length from base of first gastral tergite to apex of gaster, measured in lateral view.
- TL The total outstretched length of ant from mandibular apex to gastral apex; when measured in lateral view, the sum of mandibular length + head length + mesosomal length + length of petiole + length of gaster.

Indices

- CI Cephalic Index: $PHW/HL \times 100$.
- MdI Mandible Index: $MdL/HL \times 100$.
- SI Scape Index: $SL/PHW \times 100$.

Collection Abbreviations (mostly from Brandão, 2000)

- ANIC Australian National Insect Collection, Canberra, Australia.
- BMNH Natural History Museum, London, UK.
- MCZC Museum of Comparative Zoology, Harvard University, Cambridge, MA, USA.
- NMNH Philippine National Museum of Natural History, Manila, Philippines.
- UPLB University of the Philippine Los Baños, Museum of Natural History Entomological Collection, Los Baños, Laguna, Philippines.
- USNM United States National Museum of Natural History, Washington, D.C., USA.

Specimens were examined and measured with a Leica S8 stereomicroscope with ocular micrometer. Images of the wings, head, and antennae were created using a Leica MC120HD digital camera attached to the Leica S8 stereomicroscope. These images were stacked using Combine ZM. The stacked images were edited with Adobe Photoshop CS5. Images of the external genitalia were created with Leica DFC 450 digital camera attached to a Leica M205C stereomicroscope. These source images were stacked with Helicon Focus 5.3 64X. Stacked images were edited with Adobe Photoshop CS5 Extended.

Results

Taxonomy

Odontomachus Latreille, 1804

Type species: *Formica haematoda* Linnaeus, 1758, by monotypy.

Odontomachus ferminae General sp. n.

[urn:lsid:zoobank.org:act:D81C7347-3F49-4641-8F98-A2AE25CC772C](https://zoobank.org/act:D81C7347-3F49-4641-8F98-A2AE25CC772C)

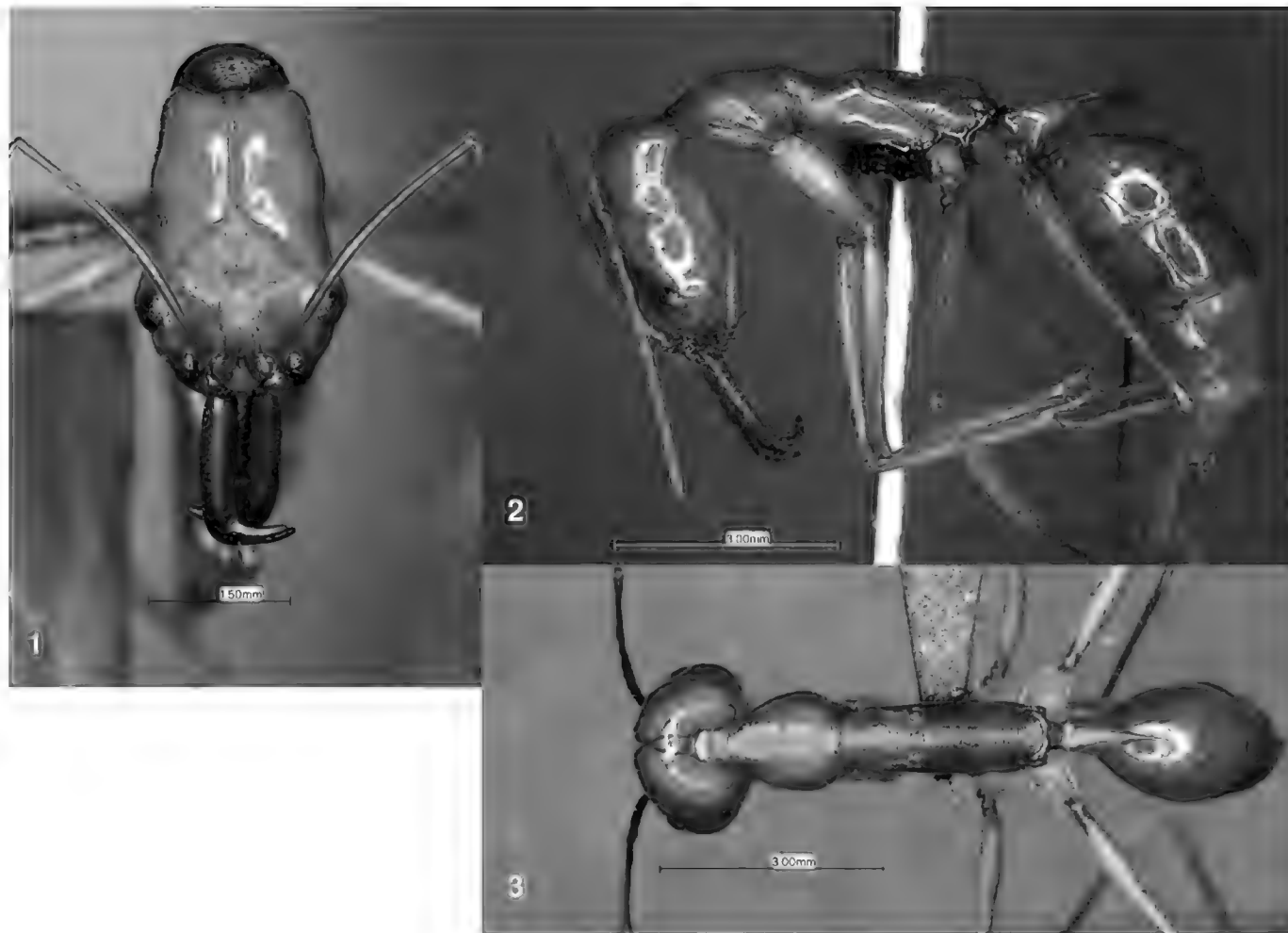
Measurements and indices

Worker measurements of holotype worker (paratype (n=16) mean: range in brackets): MdL 1.8 (1.8 [1.4-1.9]), HL 3.1 (3.2 [2.6-3.4]), HW 2.2 (2.2 [1.8-2.4]), SL 3.1 (3.1 [2.7-3.3]), ML 4.2 (4.4 [3.6-4.6]), PnW 1.3 (1.3 [1.0-1.4]), PtH 1.3 (1.3 [1.1-1.5]), PtL 1.3 (1.4 [1.2-1.5]), PtW 0.5 (0.5 [0.4-0.5]), GL 3.7 (3.8 [2.9-4.7]), TL 14.1 (14.5 [11.7-15.6]).

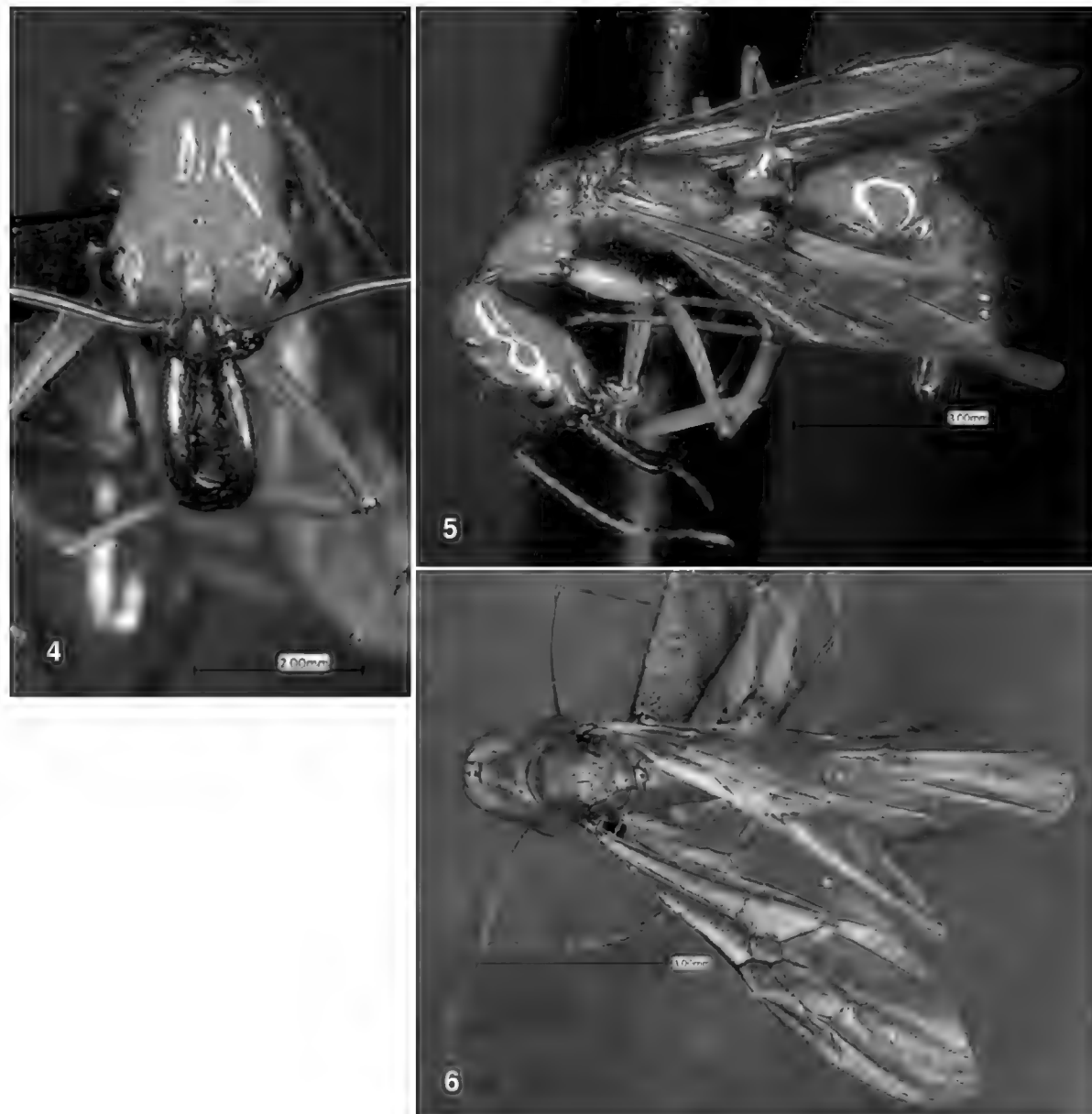
Indices: CI 71 (69 [67-72]), MdI 58 (56 [52-61]), SI 141 (141 [135-150]).

Diagnosis of worker (Figures 1-3), distinguishing characters in boldface:

Member of *infandus* species-group; in full-face view, **posterior dorsum of head entirely smooth**; median furrow deeply impressed; frons with striations radiating fan-like from frontal carinae to anterior edge of ocular ridge; apical and subapical mandibular teeth acute; in lateral view, **mesopleuron mostly smooth, with some striations at anterior third of pleurite**; petiolar spine long; first gastral tergite dorsally flattened, without a longitudinal impression; in dorsal view, **pronotum**



Figures 1-3. *Odontomachus ferminae* sp. n. Paratype worker: 1) full-face view; 2) lateral view; 3) dorsal view.



Figures 4-6. *Odontomachus ferminae* sp. n. Female alate paratype: 4) full-face view; 5) lateral view; 6) dorsal view.

transversely striate; head and body concolorously light orange; legs yellow.

Description of worker (Figures 1-3):

In full-face view, head longer than broad, widest at level of eyes; posterior margin of head broadly emarginate; emargination delineated by nuchal carina; posterior dorsum of head entirely smooth; temporal ridge low but distinct; extraocular furrow present; ocular ridge prominent; median furrow deeply impressed, terminating at striations of frons; compound eyes dorsolaterally positioned, not breaking the lateral margin of head; mandibles relatively short (mean MdL = 1.76 mm; mean MdI = 56); apical and subapical mandibular teeth acute; intercalary tooth acute and prominent, shorter than apical tooth; one row of mesal teeth present; mesal teeth triangular, decreasing in size posteriorly; second mesal tooth largest.

In lateral view, mesosoma long and slender; pronotum weakly convex; promesonotal suture prominent; anterior mesonotum higher than pronotum; metanotal groove impressed; propodeal dorsum much longer than propodeal declivity; metanotal spiracle large, situated dorsolaterally; propodeal spiracle small and slit-like, situated laterally, just above the interruption of the transverse striations of the lateral face of the posterior mesosoma; metapleural gland bulla prominent; metapleural gland orifice oval, directed dorsally; petiole supplanted by a sharp spine; anterior face of petiole sloping upward from a basal transverse carina (= anterior collar of Brown, 1976); posterior face sinuate; ventral petiolar process keel-like; first gastral tergite dorsally flattened but without a linear medial impression; sting long and functional.

Sculpture: frons with striations radiating fan-like from frontal carinae to anterior edge of ocular ridge; in lateral view, mesopleuron mostly smooth, with some striation at anterior third of pleurite; metapleuron transversely striate; in dorsal view, mesosoma and propodeal declivity transversely striate; petiole and gaster smooth.

Pilosity: a pair of erect hairs at center of frons; a transverse row of four long, erect hairs at center of pronotum (one hair broken off in holotype); very short decumbent pilosity scattered on

mandible, median clypeus, antennal scape, and dorsum of head and mesosoma.

Colour: antenna, head and body concolorously brownish orange; mandibles brown; legs yellow.

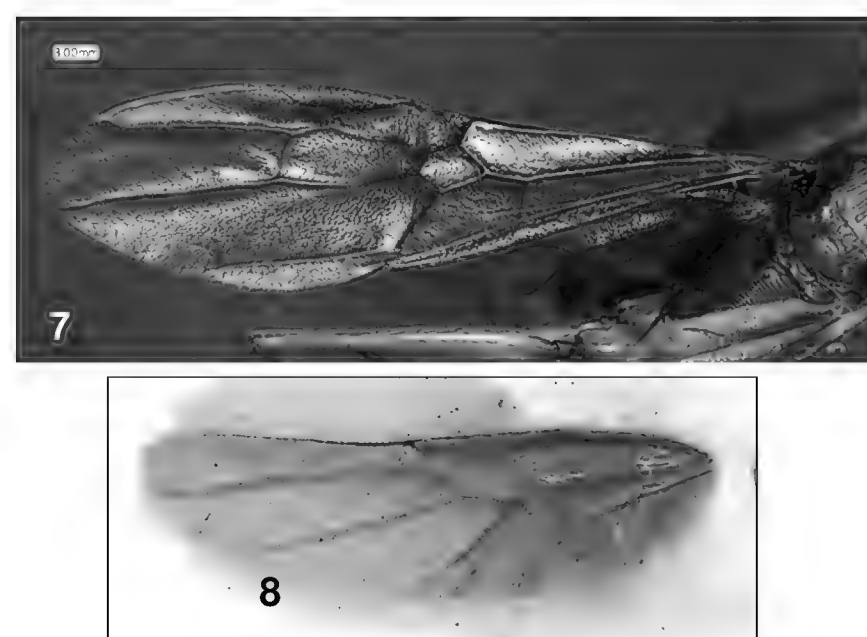
Description of alate female (Figures 4-8):

Head as in worker, but with the following differences: posterior margin of head more shallowly emarginate; 3 ocelli present at median apex of frons; each lateral ocellus behind erect hair at center of head; lateral ocelli separated by less than diameter of lateral ocellus.

In lateral view, full complement of flight sclerites present; wings present; dorsal outline of pronotum flat; promesonotal junction rigid but distinct; mesoscutum arched; mesoscutellum domed, higher than mesoscutum; metanotum a narrow transverse plate; propodeum, petiole, and gaster similar to that of worker.

Sculpture: pronotum dorsally transversely striate, laterally with curved striations forming a horseshoe shape; mesoscutum longitudinally striate; dome of mesoscutellum smooth; propodeum transversely striate; petiole and gaster smooth.

Pilosity: a long, obliquely directed erect hair arising just anterior to each lateral ocellus; a transverse row of four erect, somewhat flexuous, hairs arising slightly behind midlength of pronotum; very short decumbent pilosity scattered on mandible, median clypeus, antennal scape, and dorsum of head and mesosoma.



Figures 7-8. *Odontomachus ferminae* sp. n. Female alate paratype: 7) Forewing; 8) Hindwing (note: jugal lobe obscured by accidental tear during imaging).

Forewing: pterostigma large; seven closed cells present; free abscissae present, Mf4-6 and CuAf4-5; Rsx abscissa absent, as depicted in Figure 7.

Hindwing: jugal lobe present; venation as depicted in Figure 8.

Colour: same as the worker.

Material examined

Holotype worker: "PHILIPPINES: Romblon Province, Sibuyan Island, Municipality of Magdiwang, Mt. Guiting-guiting Natural Park, 04.VI.2016, leg. D.E.M. General, ex. trail series, UPLBMNH HYM-01646 (deposited in UPLB).

Paratypes: 2 workers, same data as holotype, UPLBMNH HYM-01647 through 01648 (deposited in UPLB, NMNH); 12 workers, 1 alate female, PHILIPPINES: Romblon Province, Sibuyan Island, Municipality of Magdiwang, Mt. Guiting-guiting Natural Park, 24-31.III.2017, leg. C.C. Lucañas, UPLBMNH HYM-01649 through 01661 (one worker each deposited in ANIC, BMNH, MCZC, NMNH, USNM, the rest of the workers and the alate female deposited in UPLB). Non-type material: 2 workers, same data as holotype but with badly damaged or detached gasters, UPLBMNH HYM-01662 through 01663.

Bionomics: This ant is locally abundant at lower elevations of Mt. Guiting-guiting, specifically the area around "Camp 1", at about 300 meters above mean sea level. They can be seen foraging along the trail to Camp 1 and in the leaf litter and open ground in the Camp. They are evidently tolerant to some degree of disturbance since the area is a semi-permanent trail and campsite.

Etymology: This species is lovingly dedicated to my late mother, Fermina M. General.

Comparative Notes

Possessing acute apical and subapical teeth, *Odontomachus ferminae* **sp. n.** clearly belongs to the *infandus* species group. However, it is easily distinguished from the known species of the group by its smooth posterior dorsum of head, mesopleuron that is mostly smooth, transversely striate dorsum of the pronotum, first gastral tergite flattened but

without a longitudinal impression, and its unique coloration of light orange head and body and yellow legs.

Discussion

Odontomachus ferminae **sp. n.** is similar in size and colour to local populations of *Oecophylla smaragdina* L. It is possible that there is a Müllerian mimicry system between these two species. This possible relationship should be investigated further.

Using the key of Brown (1976), *O. ferminae* **sp. n.** keys out to the couplet that separates *O. banksi* Forel, 1910 and *O. infandus* F. Smith, 1858, both members of the *infandus* species group.

In the key of Sorger and Zettel (2011), this species, with its smooth posterior dorsum of head, fails to satisfy either lug of Couplet 4. Couplet 4 separates species with punctured posterior dorsum of head from those with striate posterior dorsum of head. Thus, it is a simple matter for separating *O. ferminae* **sp. n.** from the rest of the *infandus* group. The following couplet may be inserted before Couplet 4 of the Sorger and Zettel (2011) key:

Posterior dorsum of head smooth and shiny.....*Odontomachus ferminae* **sp. n.**
Posterior dorsum of head sculptured, either punctured or striate.....5

Acknowledgments

I am very grateful to Perry Buenavente for imaging the specimens. I thank the Philippine National Museum of Natural History for allowing me to use their equipment to measure and observe this ant species for this paper. I also thank Dr. Aimee Lynn B. Dupo for allowing me to join her reconnaissance visit to Mt. Guiting-guiting Natural Park, when I first encountered these ants and Cristian C. Lucañas for collecting more specimens for me. Finally, I would like to thank the Protected Area Management Board of Mt. Guiting-guiting Natural Park, led by their Protected Area Supervisor, Mr. Malvin Rocero, for their hospitality and permission to collect specimens.

References

- Bolton, B. 2018. An online catalog of the ants of the world. Accessed online at <http://antcat.org>.
- Brandão, C.R.F. 2000. Major regional and type collections of ants (Formicidae) of the world and sources for the identification of ant species. *In*: D. Agosti, , J.D. Majer, , L.E. Alonso, & T.R. Schultz, (eds.) *Ants: standard methods for measuring and monitoring biodiversity*. Washington, DC: Smithsonian Institution Press, 172-185.
- Brown, W.L. Jr. 1976. Contributions toward a reclassification of the Formicidae. Part VI. Ponerinae, Tribe Ponerini, Subtribe Odontomachiti. Section A. Introduction, Subtribal Characters. Genus *Odontomachus*. *Studia Entomologia* (N.S.) 19: 67-171.
- General, D.M. and Alpert, G.D. 2012. A synoptic review of the ant genera (Hymenoptera: Formicidae) of the Philippines. *ZooKeys* 200: 1-111.
- Shattuck, S.O., Alpert, G.D., Lubertazzi, D. 2018. AntWiki. Accessed online at <http://www.antwiki.org/wiki/>.
- Sorger, D.M. and Zettel, H. 2011. On the ants (Hymenoptera: Formicidae) of the Philippine Islands: V. The genus *Odontomachus* Latreille, 1804. *Myrmecological News* 14:141-163.

A *Chaetogramma* Doult (Hymenoptera: Chalcidoidea) from India

*Mohd Talib Khan & Shoeba Binte Anis

Department of Zoology, Aligarh Muslim University, Aligarh 202002, India.

(Email: athamohd@gmail.com)

Abstract

The male *Chaetogramma hisarensis* Yousuf & Shafee (1993) is recorded and diagnoses of the three known Indian species are given. A key to the three Indian species of *Chaetogramma* is also provided.

Keywords: *Chaetogramma*, India, records, key.

Received: 22 May 2017; Revised: 21 September 2018; Online: 10 October 2018.

Introduction

Chaetogramma Doult, is represented by 6 species worldwide of which 3 species are recorded from India. Two species were described by Hayat, *C. borealis* Hayat (2008) and *C. maculata* Hayat (1981) and one species by Yousuf & Shafee, *C. hisarensis* Yousuf & Shafee (1993). In this paper a detailed description of the newly recorded male of *C. hisarensis* is provided along with diagnostic characters of the three known Indian species. A key to the three Indian species of *Chaetogramma* is also given.

Materials and Methods

Only body lengths are given in millimeters; all other measurements are relative, taken from the divisions of a linear scale of a micrometer placed in the eye piece of a stereo zoom binocular microscope (Olympus SZX16) at 10× Zoom 8 for card-mounted specimens and placed in the eye piece of a compound microscope (Nikon Eclipse 80i) at 400× magnification. Body colours were noted from card-mounted specimens prior to mounting these on slides. The photographs of card-mounted specimens were taken by stacking microscope (Nikon SMZ25) with digital camera (DS-Fi2) and of the slide-mounted specimens were taken by digital camera (Leica, DFC295) fitted over the compound microscope (Leica, DM2500). The specimens, not listed as 'on slide' are card mounted.

The following abbreviations used.

F1, F2= Funicle segments 1, 2.

TI, TII, TIII etc.= Tergites 1, 2, 3, etc. of gaster.

The following acronyms are used for the depositories.

ZDAMU = Insect Collections, Department of Zoology, Aligarh Muslim University, Aligarh, India.

NPC= National Pusa Collection, Division of Entomology, IARI, New Delhi, India.

BMNH= The Natural History Museum, London, England.

Genus *Chaetogramma* Doult

Chaetogramma Doult, 1975: 238. Type species *Chaetogramma occidentalis* Doult, by original designation.

Chaetogrammina Hayat, 1981: 73. Type species *Chaetogramma (Chaetogrammina) maculata* Hayat, by monotypy and original designation. (as subgenus of *Chaetogramma*).

Brachistagrapha De Santis, 1997: 9. Type species *Brachistagrapha candata* De Santis, by original designation. Synonymy by Pinto & Viggiani, 2004: 269–294.

Diagnosis

Female. Head with lower torular margin placed at or slightly above the level of lower eye margin; Mandible tridentate; antennal formula, 1, 1, (2), 1–2, 1; funicle either one or two segmented (F1 and F2), if two segmented,

segments either sub-equal or F1 distinctly shorter than F2, each with placoid and basiconic peg sensilla; clava unsegmented, posses both placoid and basiconic peg sensilla; mid lobe of mesoscutum and scutellum each with 2 pairs of (2+2) setae; fore wing densely setose, few setae arranged in rows basally, but become obsolescent apically, marginal fringe short; RS1 absent; stigmal vein short, not distinctly attached to marginal vein; marginal vein normal or gradually widened at apex, with few setae along the margin; propodeum as long as or longer than metanotum; ovipositor short, either slightly or not extending beyond apex of gaster.

Male: Head with frontovertex yellow, eyes and ocelli red, toruli placed above level of lower eye margin, maxillary palp unsegmented, with two apical setae, a long [longer than maxillary palp] and a short setae. Mandible brown, three segmented. Antenna yellow except clava pale brown; Antennal formula 1, 1, (2), 1-2, 1, funicle and claval segments as in female. Fore wing hyaline, with slight infumation basally, distinctly infuscated below stigmal vein. Hind wing hyaline. Legs yellow. Gaster longer than mesosoma. Male genitalia with apodeme either absent or poorly developed; anterodorsal aperture oval, short, broad medially and open dorsally; parameres absent; aedeagus short.

Comments: Hayat (1981) divided the genus *Chaetogramma* into two subgenera such as *Chaetogramma* sens. str. and *Chaetogrammina* erected as new subgenus for *C. maculata*, based on completely divided funicle segments, well developed costal cell, broader fore wing and more distinct vein tracks, however the nominate genus have, funicle either one or two segmented; the two segmented funicle is partially divided and cannot easily be discernable as separate segments.

The male genitalia of *Chaetogrammina* have poorly developed apodemes, while the nominate genus *Chaetogramma*, has apodemes either developed or absent (If present, it can easily be seen “reaching to anterior apex of phallus” but in *Chaetogrammina* apodemes are short, not reaching the anterior apex of phallus, but can be seen slightly above the base of anterodorsal aperture).

***Chaetogramma hisarensis* Yousuf & Shafee**

(Figures, 1–11)

Chaetogramma hisarensis Yousuf & Shafee, 1993: 49–50. female. Holotype, female, Haryana, Hisar (ZDAMU examined).

Chaetogramma hisarensis Yousuf & Shafee: Hayat, 2008a: 4–5.

Diagnosis

Female: Length, 0.46 mm. Head largely yellowish; gena with two brown patches below lower eye margin and above mouth margin; eyes and ocelli red. Mandible brown. Antenna yellowish brown. Mesosoma, anterior pronotum dark brown, most part of mid lobe of mesoscutum orange, rest of scutum, scutellum, metanotum and propodeum yellow. Fore wing hyaline with slight infumation basally and a distinct infuscated patch below stigmal vein. Hind wing hyaline. Legs pale except hind coxa, two-thirds femur and hind tibia brown. Gaster largely yellowish, tergite TII to TV and TVII alternate with yellow and dark brown bands.

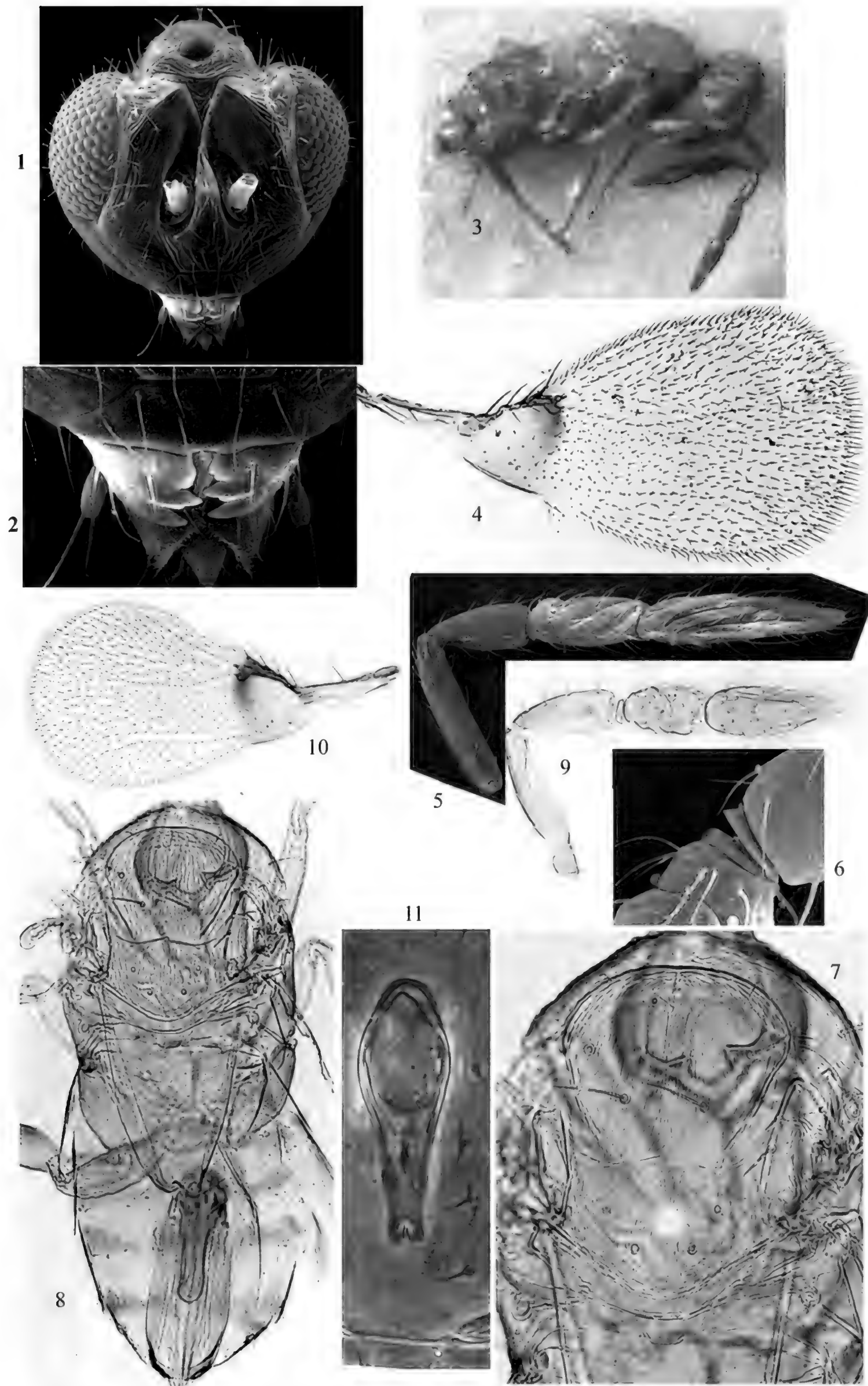
Head (Fig. 1) in frontal view slightly broader than high (12:10). Mandible (Fig. 2) tridentate. Antennae (Fig. 5) with scape cylindrical, 4.1× as long as broad; pedicel long, conical, 2× as long as broad; 2 anelli (Fig. 6) present; funicle two segmented (F1 and F2), 1.84× as long as broad, second funicular segment more than thrice as long as first funicular segment; clava one segmented, 2.93× as long as broad.

Mesosoma (Fig. 7): pronotal collar with three pairs of setae, one at anterolateral corner longer. Fore wing (Fig. 4), 2× as long as broad, discal setae densely setose, few setae arranged in rows; marginal vein longer than premarginal or stigmal veins; marginal fringe short, 10.4× of wing width.

Metasoma (Fig. 8): Gaster longer than mesosoma, (119:81); ovipositor moderately long, extending from tergite TIII of gaster, hardly exserted; ovipositor, 1.30× hind tibial length.

Male: Length, 0.49 mm. Head yellowish; eyes and ocelli red. Mandible brown. Antennae yellowish except clava pale brown. Mesosoma with pronotum, mesoscutum, scutellum, metanotum and propodeum yellow. Fore wing hyaline with slight infumation basally and infuscated below stigmal vein. Hind wing

A Chaetogramma Doult (Hymenoptera: Chalcidoidea) from India



FIGURES (1-11). *Chaetogramma hisarensis*, **female:** 1, head; 2, mandible; 3, habitus; 4, fore wing; 5, antenna; 6, anelli; 7, mesosoma; 8, body. **male:** 9, antenna; 10, fore wing; 11, phallus.

hyaline. Legs yellow. Gaster largely yellowish, tergite from TI–TVI with alternate yellow and dark brown bands.

Head in frontal view as broad as high (13:13). Maxillary palp one segment with two apical setae, a long [longer than maxillary palp] and a short seta. Mandible tridentate. Antenna (Fig. 9) with scape broad medially, $2.58\text{--}3.1\times$ as long as broad; pedicel long, conical, broad at apex, $2\text{--}2.3\times$ as long as broad; 2 anelli present; funicle two segmented (F1 and F2), $1.58\text{--}2.1\times$ as long as broad, clava one segmented, with 3 placoid sensilla, $2.46\text{--}2.53\times$ as long as broad.

Mesosoma: Sculpture on mesosoma same as female; propodeum as long as metanotum. Fore wing (Fig. 10), $1.89\text{--}2.07\times$ as long as broad, discal setae densely setose, marginal vein longer than combined lengths of premarginal and stigmal veins; marginal fringes short, $11.55\text{--}14\times$ of wing width.

Metasoma: Gaster longer than mesosoma, (145:104); phallus (Fig. 11) short, arise from posterior tergite TV of gaster; anterodorsal aperture oval shaped, open dorsally; parameres without spines; aedeagal apodemes absent; $0.42\text{--}0.49\times$ hind tibia length.

Relative measurements: length of scape, 31; width of scape, 10; length of pedicel, 23; width of pedicel, 10; length of funicle 19; width of funicle 12; length of clava, 32; width of clava, 13; fore wing length; 212; fore wing width, 112; submarginal vein length, 40; marginal vein length, 25; premarginal vein length, 17; stigmal vein length, 7; length of marginal fringe of fore wing, 10; length of hind tibia, 62; length of phallus, 26.

Type material examined: Holotype: female, (on one slide), labelled, “M.Y.R.A707 *Chaetogramma hisarensis* sp.n. M.Yousuf near Mini Secretariat, Hisar, 26.iii.1991” and a ticket with ‘Holotype’ written in black ink, Det. by M. Hayat 2007 (ZDAMU, HYM/CH 419).

Additional material examined: INDIA: ANDHRA PRADESH: East Godawari, Sarpavaram, 1 female, 2 females (on slides), 5.ii.2014, coll. MT Khan; East Godawari, VK Rayapuram, 2 females (on slides), 5.ii.2014, coll. SK Ahmad; Guntur, Kolanukonda, 1 female (on slide), 11.ii.2014, coll. SK Ahmad;

Krishna, Chepalakundi, 1 female, 12.ii.2014, coll. SK Ahmad. UTTAR PRADESH: Aligarh, Dept. of Zoology, 1 male, 2 males + 1 female (on slides), 26.viii.2014, coll. MT Khan.

Host: Unknown

Distribution: India: Earlier recorded from Haryana and presently from Andhra Pradesh, Uttar Pradesh.

Comments: The original description of this species is based on single female; I have collected a female and three males from the same locality and rest of the specimens collected from different locations. The male is similar to female based on sculpture of mesoscutum and scutellum, number of funicular segments and habitus but differs in antennal structure, where funicle segments F1 and F2 subequal in length; clava shorter and with a few placoid sensilla.

Chaetogramma borealis Hayat

Chaetogramma borealis Hayat, 2008b: 118–119. female. Holotype, female, Uttar Pradesh, Pilibhit, Rooppur Kirpa (NPC not examined). (Paratype in ZDAMU examined).

Chaetogramma borealis Hayat, 2009: 202. female. Uttar Pradesh record.

Diagnosis

Female: Length, 0.71 mm. Head with frontovertex yellowish; face pale brown; gena below lower eye margin with a triangular dark brown spot, rest pale brown to yellowish; occiput from the foramen downward brown. Mandible brown. Antenna brown except apical half of pedicel pale. Mesosoma with pronotum dark brown anteriorly, rest pale brown to colourless; mid lobe of mesoscutum largely orange with two brown vertical bands laterally, rest of scutum yellowish; scutellum yellowish with two brown spots mediolaterally, axillae yellow; metanotum medially pale yellow rest brown; propodeum pale yellow; most part of mesopleura colourless to pale yellow except a brown band medially. Fore wing hyaline with slight infumation below venation and a distinct infuscated patch below stigmal vein. Hind wing hyaline. Legs pale brown except basal three–fourth of hind femur brown. Gaster dark brown

except posterior tergite TVI and TVII pale yellow. Head in frontal view slightly broader than high. Mandible tridentate. Antenna with scape, $3.7\times$ as long as broad; pedicel conical, $1.83\times$ as long as broad; 2 anelli present; funicle one segmented, $1.28\times$ as long as broad; clava one segmented, $2.05\times$ as long as broad. Fore wing, $2.14\times$ as long as broad, discal setae densely setose, not arranged in rows; marginal vein broadened distad, longer than combined lengths of premarginal and stigmal veins; marginal fringe short, $5.82\times$ of wing width. Gaster longer than mesosoma, (155:99); ovipositor moderately long, extending from tergite TIII of gaster, and hardly exerted; ovipositor, $1.72\times$ hind tibia length.

Male. Unknown.

Type material examined: Holotype: female (on one slide). INDIA: Uttar Pradesh: Pilibhit; Roop Pur Kirpa, 24.ix.2006, coll. SMA Badruddin and FR Khan.

Paratype: 1female (on one slide under three small cover slips), Uttar Pradesh: Bahraich; Tikona Mod, 1.x.2006, coll. FR Khan (ZDAMU, HYM/CH 556, examined).

Additional material examined: INDIA: ANDHRA PRADESH: Krishna, Chepalakundi, 1female, 1 female (on slide), 12.ii.2014, coll. SK Ahmad; Krishna, Chepalakundi, 2 females, 1 female (on slide), 12.ii.2014, coll. MT Khan; Guntur, Rajamandi, 2 females, 10.ii.2014, coll. MT Khan; East Godawari, Sarpavaram, 1 female, 5.ii.2014, coll. MT Khan. KARNATAKA: Mandya, Narayan, Gowda, 1 female, 2.i.2014, coll. FR Khan.

Host: Unknown.

Distribution: India: Earlier recorded from Uttar Pradesh and presently from Andhra Pradesh and Karnataka.

***Chaetogramma maculata* Hayat**

Chaetogramma (*Chaetogrammina*) *maculata* Hayat, 1981: 74–75. female. Holotype, female. Uttar Pradesh, Aligarh (BMNH, not examined). [Paratypes, ZDAMU examined].

Chaetogramma maculata Hayat: Hayat & Viggiani, 1984: 26, catalogue.

Brachygrammatella singularis Yousuf & Shafee, 1985: 305. female. Holotype, female, Uttar Pradesh, Aligarh (ZDAMU, examined). Synonym by Hayat, 2008a: 5.

Chaetogramma maculata Hayat: Hayat & Subba Rao, 1986: 194, catalogue. Yousuf & Shafee, 1988: 123, figures, key. Hayat, 2008a: 5, taxonomy.

Chaetogramma singularis (Yousuf & Shafee): Yousuf & Shafee, 1988: 123, 125, figures, key.

Diagnosis

Female: Length, 0.71 mm. Head with frontovertex, face and gena brown; eyes and ocelli red. Mandible brown. Antenna dark brown. Thorax dark brown. Fore wing hyaline, infusate basally. Hind wing hyaline. Legs pale brown. Gaster pale brown with small patches laterally. Head, mandible tridentate. Antenna with scape long, $3.45\times$ as long as broad; pedicel long, conical, $2.7\times$ as long as broad; 2 anelli present; funicle two segmented, segments divided completely, slightly twisted, $1.61\times$ as long as broad; clava one segmented, $3\times$ as long as broad. Mesosoma, pronotal collar with two pairs of setae; propodeum as long as metanotum. Fore wing, $2.19\times$ as long as broad, discal setae densely setose, vein tracks discernable basally, but become obsolescent apically; costal broad; marginal vein broad, longer than premarginal; stigmal vein short, distinctly attached to marginal vein; marginal fringe short, $13.87\times$ of wing width. Metasoma, ovipositor $1.91\times$ hind tibia length.

Male: Similar to female except antenna, with first funicle distinctly longer than second segment and genitalia with phalobase spindle shaped, apodeme poorly developed, aedeagus short, digiti without spines.

Type material examined: Holotype, female, INDIA: Uttar Pradesh: Aligarh, January, 1980, coll. M. Hayat. (BMNH, not examined).

Paratypes. 1female, 1male, (on two slides, each under a large circular), India: Uttar Pradesh: Aligarh, December, 1979, coll. M. Hayat (ZDAMU, HYM/CH 185).

Material examined: Holotype, female (on two slides), labelled, “342 *Chaetogramma singularis* sp.n. M.Akbar, Aligarh, 26.iii.1985” and a ticket

with 'Holotype' written in red ink (ZDAMU, HYM/CH 275).

Host: Unknown.

Distribution: India: Uttar Pradesh.

Key to Indian species (female, male)

1. Antenna with funicle two segmented.....2
- Antenna with funicle one segmented.....
.....**C. borealis Hayat**
2. Female, first funicle segment short, F2, 3.8× F1; scape at least 4× as long as broad and ovipositor not more than 1.5× as long as hind tibia; male, phallus oval shaped, apodemes absent, parameres without spines.....**C. hisarensis Yousuf & Shafee**
- Female, first funicle segment slightly shorter than F2, 1.3× F1; scape 3.45× as long as broad and ovipositor 1.91× as long as hind tibia; male, phallus spindle shaped, apodemes poorly developed.....
....**C. (Chaetogrammina) maculata Hayat**

Acknowledgements

We are very thankful to Dr. Mohammad Hayat, Principal Investigator ICAR-NPIB, for providing research material and for his valuable suggestions. We thank the Chairman, Department of Zoology, Aligarh Muslim University, Aligarh, for providing research facilities and also thankful to Dr. Mohd. Yousuf, Scientist G, Forest Entomology Division, Forest Research Institute, Dehradun for reviewing this paper. Mohd Talib Khan also thankful to University Grants Commission for providing financial assistance.

References

- Doutt, R.L. 1975. Chaetogramma, a new genus of Trichogrammatidae (Hymenoptera: Chalcidoidea). Pan-Pacific Entomologist 50: 238–239.
- De Santis, L. 1997. Afelínidos y tricogramátidos de la colección del dr. Alejandro a. Ogloblin (Insecta, Hymenoptera) ii. Segunda Comunicación. Sesión Ordinaria Del Academia Nacional De Agronomiay Veterinaria, 51(8): 7–17.
- Hayat, M. 1981. The genera *Chaetogramma* and

Lathromeromyia from India, with descriptions of two new species. Bollettino Del Laboratorio Di Entomologia Agraria 'Filippo Silvestri', Portici 38: 73.

- Hayat, M. 2008a. Taxonomic notes on the Indian Trichogrammatidae (Hymenoptera: Chalcidoidea), with redescrptions and records of some species. Oriental Insects 42: 1–32.
- Hayat, M. 2008b. A new subgenus and three new species of Trichogrammatidae (Hymenoptera: Chalcidoidea) from India. Oriental Insects 42: 118–119.
- Hayat, M. 2009. Records and descriptions of Trichogrammatidae from India (Hymenoptera: Chalcidoidea). Oriental Insects 43: 201–227.
- Hayat, M. and Subba Rao, B.R. 1986. Family Trichogrammatidae. (In: B.R. Subba Rao; M. Hayat (eds.) – A catalogue of Chalcidoidea (Insecta: Hymenoptera) of India and the adjacent countries. Part ii) Oriental Insects 20: 194.
- Hayat, M. and Viggiani, G. 1985. A preliminary catalogue of the Oriental Trichogrammatidae (Hymenoptera: Chalcidoidea). Boll-ettino Del Laboratorio Di Entomologia Agraria 'Filippo Silvestri' 41: 23–52.
- Noyes J.S. 1982. Collecting and preserving chalcid wasps (Hymenoptera: Chalcidoidea). Journal of Natural History 16: 315–334.
- Noyes J.S. 2016. Universal Chalcidoidea Database. Available from: <http://www.nhm.ac.uk/ourscience/data/chalcidoidea/database/> (accessed March 2016).
- Pinto, J.D. and Viggiani, G. 2004. A review of the genera of Oligostini (Hymenoptera: Trichogrammatidae) with a preliminary hypothesis of phylogenetic relationships. Journal of Hymenoptera Research 13(2): 269–294.
- Yousuf, M. and Shafee, S.A. 1985. Description of two new species of Trichogrammatidae (Hymenoptera, Chalcidoidea) from India. Mitteilungen der Schweizerischen Entomologischen Gesellschaft 58: 303–304
- Yousuf, M. and Shafee, S.A. 1988. Taxonomy of Indian Trichogrammatidae (Hymenoptera: Chalcidoidea). Indian

A *Chaetogramma* Doult (Hymenoptera: Chalcidoidea) from India

Journal of Systematic Entomology 4: 55–
200.

Yousuf, M. and Shafee, S.A. 1993. A new
species of *Chaetogramma* Doult (Hymen-
optera: Trichogrammatidae) from
India. Bulletin of Pure and Applied
Sciences(a) 12(1–2): 49–50.

A new species of the huntsman spider genus *Pseudopoda* Jäger (Araneae: Sparassidae) from the Eastern Himalayas, India

John T.D. Caleb, Krishnendu Mondal & Vikas Kumar*

Centre for DNA Taxonomy, Zoological Survey of India, Prani Vigyan Bhawan, M-Block, New Alipore, Kolkata - 700053, West Bengal, India.

(Email: vikaszsi77@gmail.com)

Abstract

A new species of the genus *Pseudopoda* Jäger, 2000, *P. cheppe* sp. n. is described from the Indian Himalayas. Detailed description and illustrations are provided.

Keywords: Arunachal Pradesh, diagnosis, description, taxonomy.

Received: 2 February 2018; Revised: 9 October 2018; Online: 15 October 2018.

Introduction

The genus *Pseudopoda* was established by Jäger (2000) with *Pseudopoda prompta* (O. Pickard-Cambridge, 1885) as its type. It is the third largest genus of the family Sparassidae Bertkau, 1872 with 124 described species, of which, twelve species are known from India – *Pseudopoda abnormis* Jäger, 2001, *P. akashi* (Sethi & Tikader, 1988), *P. ashcharya* Jäger & Kulkarni, 2016, *P. fabularis* Jäger, 2008, *P. hingstoni* Jäger, 2001, *P. minor* Jäger, 2001, *P. perplexa* Jäger, 2001, *P. prompta* (O. Pickard-Cambridge, 1885), *P. shillongensis* (Sethi & Tikader, 1988), *P. sicca* Jäger, 2008 and *P. straminiosa* (Kundu, Biswas & Raychaudhuri, 1999) (World Spider Catalog, 2018). The present paper deals with the description of a new species, *P. cheppe* sp. n. from Arunachal Pradesh, belonging to the *Pseudopoda martensi*-species group (sensu Jäger, 2001).

Materials and Methods

Specimen was handpicked and preserved in 70% ethanol. Morphological examination and photography was performed with a Leica EZ4 HD stereomicroscope. All images were processed digitally with the aid of LAS core software (LAS EZ 3.0). Line drawings

were prepared with the GNU Image Manipulation Program (GIMP) (Montesanto, 2015). Leg measurements are given as: total length (femur, patella, tibia, metatarsus, tarsus). All measurements are in millimeters. Spine description is as follows: prolateral, dorsal, retrolateral and ventral. The types have been deposited in the National Zoological Collections, Zoological Survey of India (ZSI), Kolkata. Abbreviations: ALE = anterior lateral eyes; AME = anterior median eyes; CH = clypeus height; DS = dorsal shield of prosoma; E = embolus; FD = fertilization duct; Fe = femur; Mt = metatarsus; OS = Opisthosoma; Pa = patella; PLE = posterior lateral eye; PME = posterior median eye; Pp = palpus; RTA = retrolateral tibial apophysis; S = spermathecae; T = tegulum; Ti = tibia.

Taxonomy

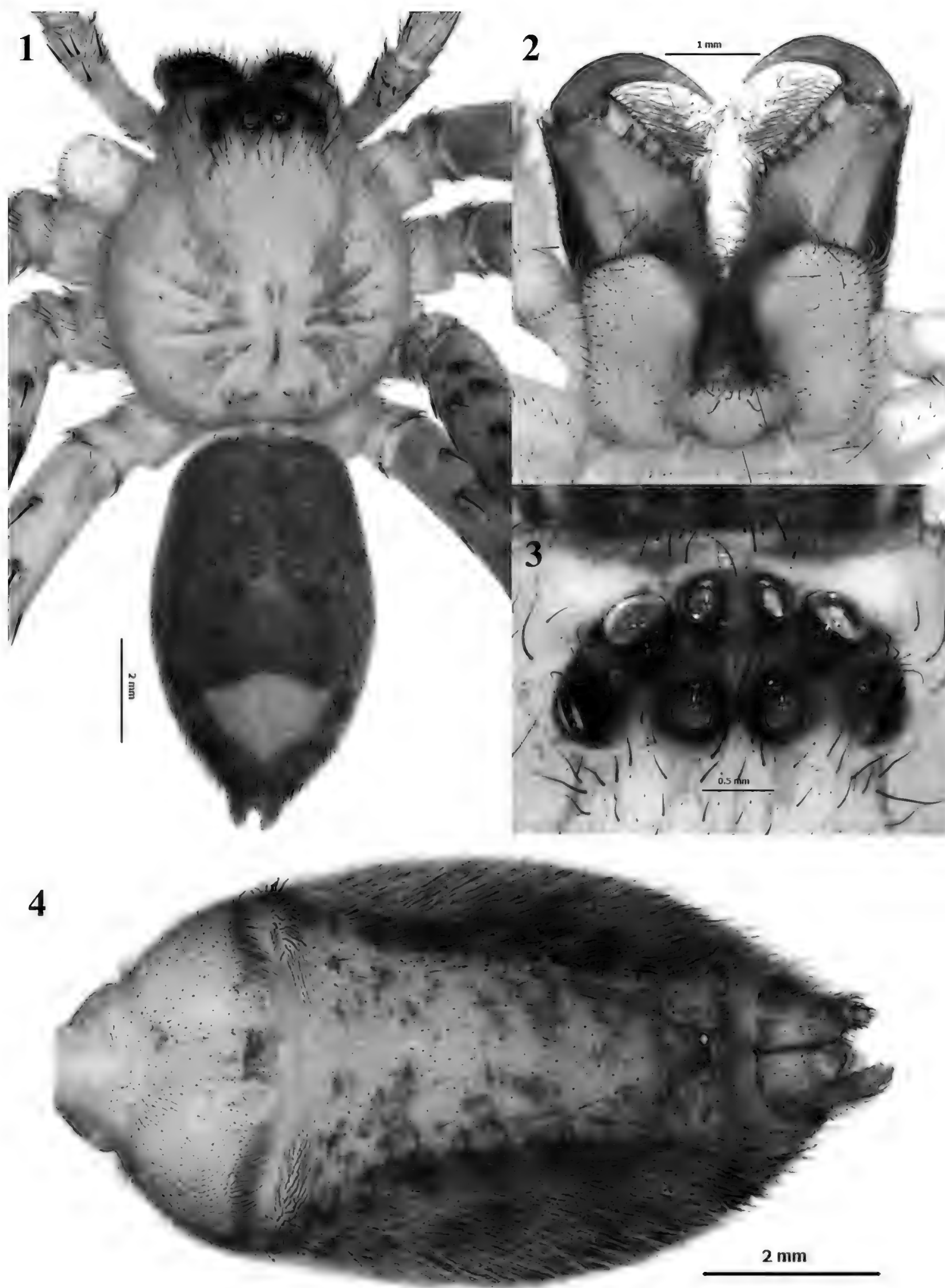
Family Sparassidae Bertkau, 1872

Genus *Pseudopoda* Jäger, 2000

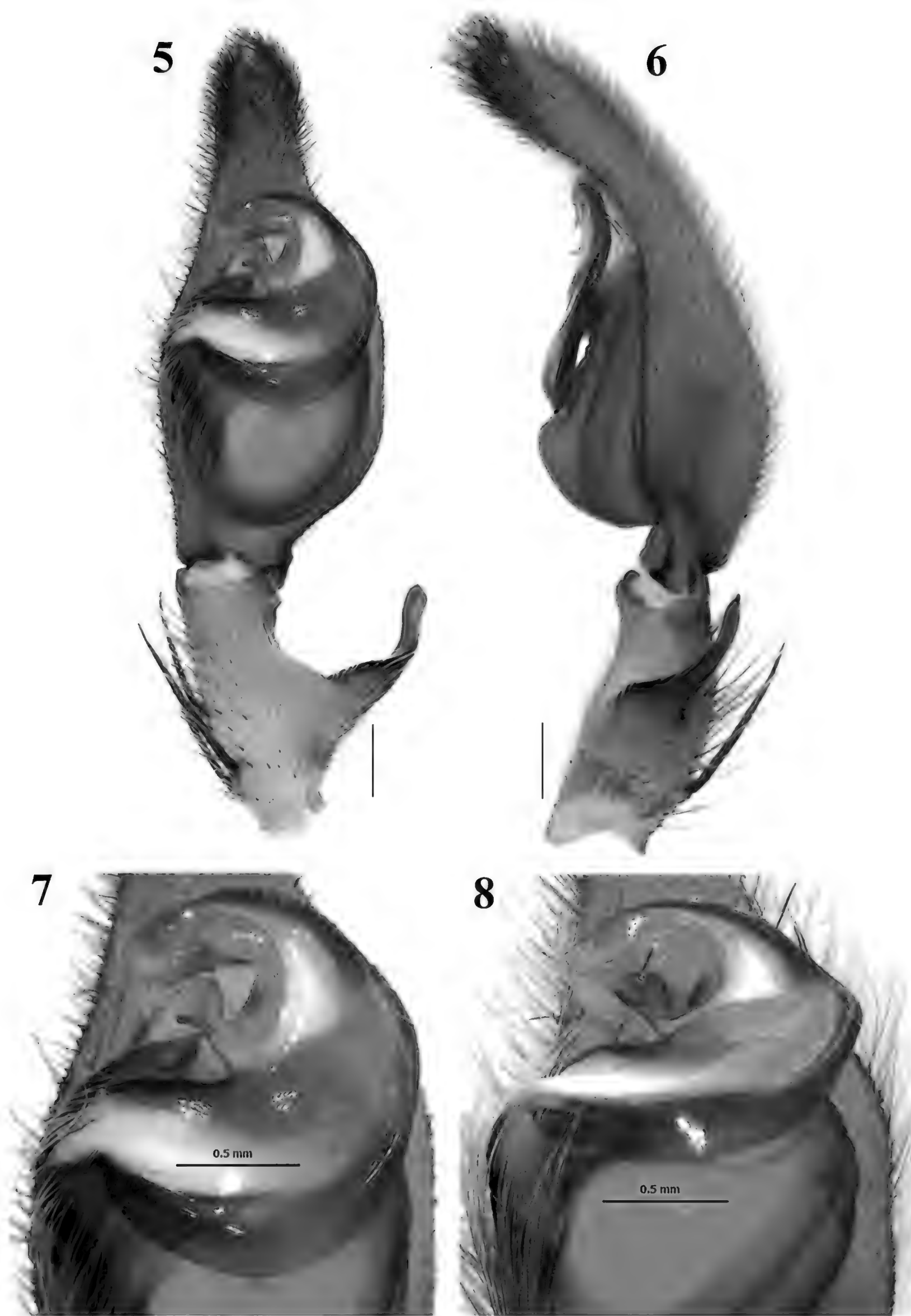
Pseudopoda cheppe Caleb sp. n.

(Figs. 1-12)

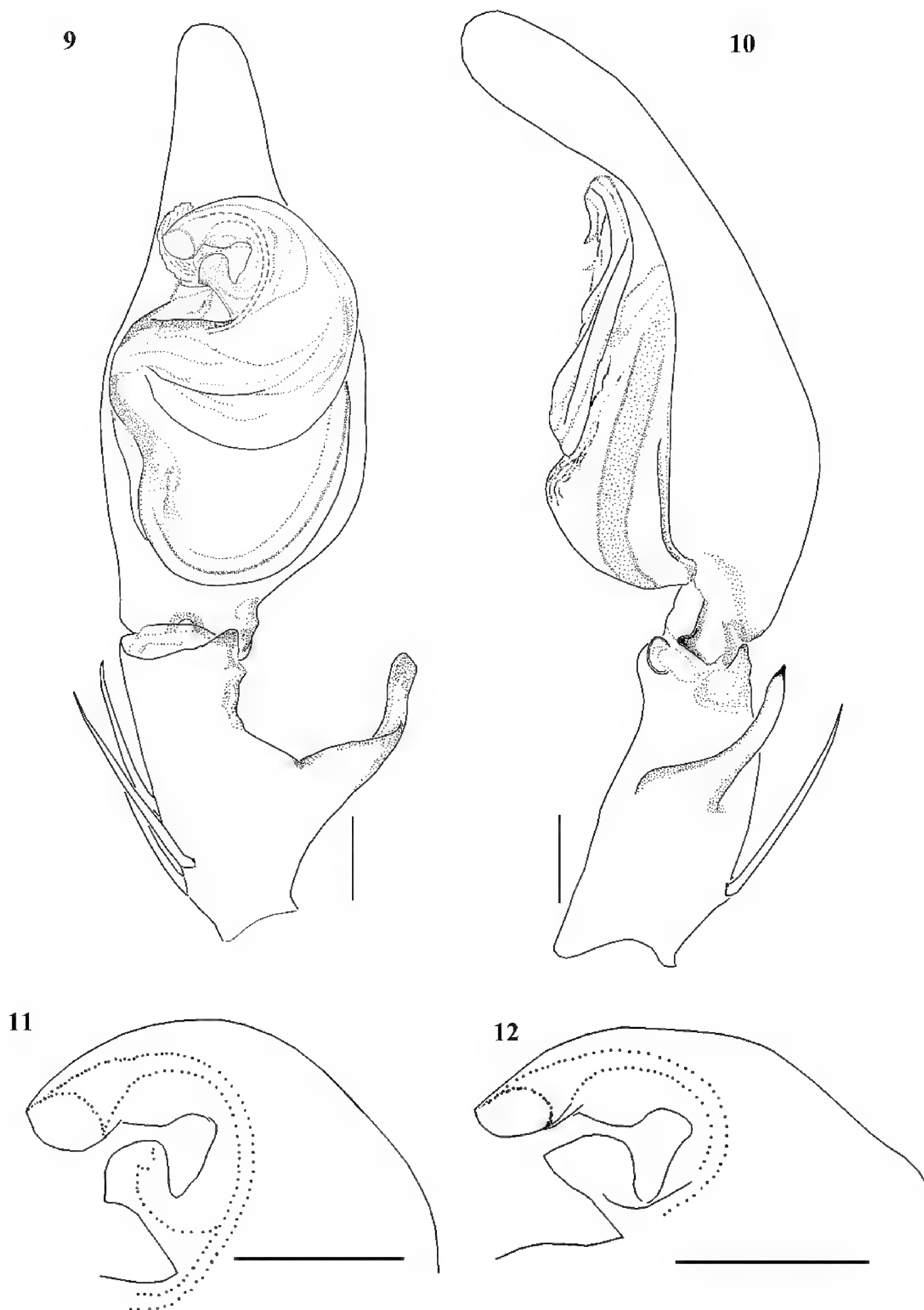
[urn:lsid:zoobank.org:act:CC1AF75C-9111-484F-A711-2CB0CB774EBB](https://zoobank.org/act:CC1AF75C-9111-484F-A711-2CB0CB774EBB)



Figures 1–4: *Pseudopoda cheppe* sp. n. holotype male (ZSI-6586/18) 1. dorsal view; 2. chelicerae, maxillae and labium; 3. eyes, dorsal view; 4. abdomen, ventral view.



Figures 5–8: *Pseudopoda cheppe* sp. n. holotype male (ZSI-6586/18) 5. male left palp, ventral view; 6. same, retrolateral view; 7. embolus detail, ventral view; 8. same, slight posterior view. Scale bars: (5–6) 0.5 mm.



Figures 9–12: *Pseudopoda cheppe* sp. n. 9. male left palp, ventral view; 10. same, retrolateral view; 11. embolus detail, ventral view; 12. same, slight proximal view. Scale bars: (9–12) 0.5 mm.

Type material:

Holotype: 1♂ (ZSI-6586/18) INDIA: Cheppe (28.6097° N, 95.4966° E), alt. 1583 m, Arunachal Pradesh, 01 September 2016, leg. Boni Amin Laskar.

Etymology: The specific name refers to the type locality. Used as a noun in apposition.

Diagnosis: Species is closely related to *Pseudopoda megalopora* Jäger, 2001, but differs in the following characters: male larger (13.4 mm) in comparison to *P. megalopora* (4.8 mm); cymbium longer and narrower distally than in *P. megalopora*; embolus ending at 11 o' clock position (comparatively shorter and stouter, ending along medial axis of palp at 12 o' clock position in *P. megalopora* (cf. Figs. 7, 8, 11, 12 with fig. 36k in Jäger 2001); embolic disc wide and protrudes slightly beyond the tegular and cymbial retrolateral margin (remains well within the margin in *P. megalopora*); RTA single, curving uniformly in retrolateral view (branched in *P. megalopora*).

Description: Male (holotype) (ZSI-6586/18): Medium sized heteropodinae. Body length 13.4. Measurements: DS length 6.6, width 5.7, OS length 6.8, width 4.3. Eyes: AME 0.30, ALE 0.46, PME 0.38, PLE 0.44, AME–AME 0.22, AME–ALE 0.10, PME–PME 0.32, PME–PLE 0.63, AME–PME 0.46, ALE–PLE 0.46, CH AME 0.70, CH ALE 0.51. Leg formula: II-I-IV-III. Spination: Pp 1310, 1010, 3100; Fe: I 324, II 423, III 323, IV 223; Pa: I–IV 101; Ti: I–II 2126, III 2326, IV 2226; Mt: I–II 1014, III–IV 2024. Measurement of palps and legs: Pp 10.71 (3.72, 1.46, 1.67, –, 3.86); I 31.83 (9.09, 2.20, 10.00, 7.37, 3.17); II 32.09 (9.70, 2.23, 9.91, 7.72, 2.53); III 27.14 (7.84, 1.90, 8.26, 6.15, 2.63); IV 30.79 (9.25, 1.97, 8.95, 7.84, 2.78). Promargin of chelicerae with three teeth and retromargin with four teeth, cheliceral furrow with ca. 49 denticles. Palp as in diagnosis. Embolus arising from 10-11 o'clock position on tegulum, sickle shaped, embolus accompanied by embolic apophysis. Spermathor distinct, widening as it reaches the tip, opening dorsally. RTA single, arising proximally to medially (Figs. 5, 6, 9, 10).

Colouration in ethanol: DS light yellow, fovea and radial furrows distinctly marked with brown colour (Fig. 1), ventrally pale; eye region dark (Fig. 3). OS reddish-brown with triangular creamy patch in posterior half and lateral black patches; mid-ventral region pale yellow with interspersed brown patches; lateral regions brownish (Fig. 4). Legs yellowish with spine patches on femora; distal segments brownish.

Female: Unknown

Distribution: India (Arunachal Pradesh).

Relationship: *Pseudopoda cheppe* sp. n. belongs to the *Pseudopoda martensi*-group s. str. due to the presence of a sub-distal embolic process (Jäger, 2001). The species is closely related to *P. megalopora* with respect to the shape of the embolic tip and close geographic proximity of their type localities. However, the RTA is single without any branching in *P. cheppe* sp. n. resembling *P. martensi* Jäger, 2001.

Acknowledgements

We are grateful to Dr. Kailash Chandra, Director, Zoological Survey of India for his encouragement and moral support and for providing necessary facilities to carry out the work. Sincere thanks to Dr. Peter Jäger for his comments and suggestions on an earlier version of the manuscript. Thanks to Dr. Boni Amin Laskar for collecting the specimen used in the study. Financial support of this project was provided by the Ministry of Environment Forest and Climate Change (MoEF & CC) through National Mission on Himalayan Studies (NMHS) project “Biodiversity Assessment through Long-term Monitoring Plots in Indian Himalayan Landscape (Project ID – NMHS/2015-16/LG-05; Project grant number – NMHS/LG2016/0011/8509)” at ZSI.

References

- Bertkau, P. 1872. Über die Respirationsorgane der Araneen. Archiv für Naturgeschichte 38: 208-233.
- Jäger, P. 2000. Two new Heteropodine genera from Southern Continental Asia (Araneae: Sparassidae). Acta Arachnologica 49(1): 61–71.

- Jäger, P. 2001. Diversität der Riesenkrabbspinnen im Himalaya -- die Radiation zweier Gattungen in den Schneetropen (Araneae, Sparassidae, Heteropodinae). Courier Forschungsinstitut Senckenberg 232: 1–136.
- Jäger, P. 2008. Three new *Pseudopoda* species from northern India (Araneae, Sparassidae, Heteropodinae). Revue Suisse de Zoologie 115: 515–526.
- Jäger, P. & Kulkarni, S. 2016. An unexpected new species of the genus *Pseudopoda* (Araneae, Sparassidae, Heteropodinae) from the Western Ghats in India. ZooKeys 577: 55–62. [doi:10.3897/zookeys.577.7848](https://doi.org/10.3897/zookeys.577.7848)
- Kundu, M., Biswas, V. & Raychaudhuri, D. 1999. New huntsman spiders (Heteropodidae: Araneae) from Buxa Tiger Reserve, Jalpaiguri, West Bengal. Journal of the Bombay Natural History Society 96: 98–105.
- Montesanto, G. 2015. A fast GNU method to draw accurate scientific illustrations for taxonomy. In: Taiti S, Hornung E, Štrus J, Bouchon D (eds.) Trends in Terrestrial Isopod Biology. ZooKeys 515: 191–206. <https://doi.org/10.3897/zookeys.515.9459>
- Pickard-Cambridge, O. 1885. Araneida. In: Scientific results of the second Yarkand mission. Calcutta, 1–115 pp.
- Sethi, V.D. & Tikader, B.K. 1988. Studies on some giant crab spiders of the family Heteropodidae from India. Records of the Zoological Survey of India, Miscellaneous Publications, Occasional Paper 93: 1–94.
- World Spider Catalog, 2018. World Spider Catalog (version 19). Natural History Museum Bern, online at: <http://wsc.nmbe.ch> (accessed on 30 January 2018).

Karyotypable somatic metaphases obtained in *Agrotis spinifera* (Noctuidae, Lepidoptera) by application of *in vitro* colchicine air drying technique

Geetanjali Dhawan

Department of Zoology, Arya P.G. College, Panipat-132103, Haryana, India.

(Email: geetanjali_dhawan@yahoo.co.in)

Abstract

A modified technique of *in vitro* colchicine treatment has been applied to the somatic chromosomes of a lepidopteran species, *Agrotis spinifera*. The aim to obtain highly elongated karyotypable elements has been achieved from the brain ganglia metaphase chromosomes of male and female revealing $2n=62$ in both the sexes which were further confirmed by diakinesis and metaphase I in male meiotic prophase chromosomes. Further, female heterogamety with ZW:ZZ sex mechanism has been evidenced on the basis of somatic karyotypes prepared from brain ganglia, chromosomal slides by using air drying Giemsa staining procedure in contrast to the usual isodiametric chromosomes obtained by conventional method of acetolactic orcein squash preparation. This is the first report of identification of sex mechanism in the species, which can be used for further investigation by application of G- and C-banding techniques.

Keywords: *karyotypes, somatic metaphases, differential staining, sex mechanism, Lepidoptera.*

Received: 16 November 2017; Revised: 8 October 2018; Online: 17 October 2018.

Introduction

Though genetical data of Lepidoptera is sufficient (Robinson, 1971), cytological proofs of their sex chromosomes and nature of centromeres are scanty (Suomalainen, 1969, 1971; Bigger, 1975, 1976; Kawazoe, 1992; Saitoh, 1989; Izumi and Seto, 1995; Sahni, 1997; Rishi *et al.*, 1997, 1999, 2000, 2001). There has been a great difficulty in discerning the homologous pairs of autosomes and the heterogametic sex chromosomes from the metaphase plates because the karyotypable elongated metaphase elements could not be obtained from somatic metaphases by earlier conventional method of acetolactic orcein squash preparation (Maeki, 1981; Rishi and Rishi, 1985, 1990; Dhawan, 2016).

Earlier technical difficulties included:

- isodiametric morphology of chromosomes
- non karyotypable elements
- tendency of chromosomes to clump together at metaphase
- sex chromosomes forming a bivalent not

recognizable by heteromorphism

- inadequacy of techniques

Female heterogamety in *Agrotis spinifera* is a new report to cytology

Materials and Methods

Different instar larvae of *Agrotis spinifera* were collected from the host plant *Helianthus annuus* in the months of April and May from Kurukshetra. Some of them were fed to maturity in the laboratory. Prepupal brain ganglia of males and females were dissected out in 0.75% sodium chloride solution containing colchicine (0.01%) and kept for 45 minutes. These tissues were then treated with 1% sodium citrate solution for 15 minutes and fixed in methanol-acetic acid (3:1) for 30 minutes. Tissues were then treated in a drop of 45% acetic acid and spread on clean slides for **air drying**. Slides were stained in 2% Giemsa. Chromosome counts were made from 50-70 metaphases in each male and female specimen from more than twenty larvae. All micrographs

were taken with Olympus PM6 photomicrograph attachment at an initial magnification of x500.

Observations and Results

The karyotypic details of male and female Giemsa stained and G-banded somatic metaphases and their karyotypes are as under:

Somatic Metaphases:

Female $2n = 62$ (Fig.1)

Male $2n = 62$ (Fig.3)

Somatic Karyotypes:

Female (Fig.2)

3 pairs of metacentrics

1 pairs of subtelocentrics

3 pairs of subtelocentrics

23 pairs of acrocentrics

1 pair of heteromorphic sex chromosome (ZW) comprising a largest acrocentric W and a second largest submetacentric Z being smaller than W but still larger than the first pair of autosomes.

Male (Fig.4)

3 pairs of metacentrics

1 pairs of subtelocentrics

3 pairs of subtelocentrics

23 pairs of acrocentrics

1 pair of sex chromosomes (ZZ) larger than the first pair of autosomes.

Chromosomal Sex Mechanism: ZW:ZZ

Chromosome Formula

Female $=6m+3sm+6st+47a$

Male $=6m+2sm+6st+48a$

Fundamental Number (FN)

Female $=71$

Male $=70$

Morphometric Data of Female Somatic

Karyotype:

Actual mean length of largest chromosome $=2.255\mu m$

Actual mean length of smallest chromosome $=0.989\mu m$

Relative length of the largest chromosome $=4.425$

Relative length of smallest chromosome $=1.941$

Ratio of largest to smallest chromosome $=2.280$

Total mean haploid length $=50.954\mu m$

Morphometric Data of Male Somatic

Karyotype:

Actual mean length of largest chromosome $=1.850\mu m$

Actual mean length of smallest chromosome $=0.650\mu m$

Relative length of the largest chromosome $=4.722$

Relative length of smallest chromosome $=1.659$

Ratio of largest to smallest chromosome $=2.846$

Total mean haploid length $=39.179\mu m$

Spermatogonial Metaphase (Fig.5): $2n=62$

Polyploidy (Fig.6):

Polyploidy is very common among the spermatogonial metaphases from larval testes. Figure 6 shows a highly polyploid nucleus under the effect of colchicine treatment. Almost all the elements reveal clear splitting of the chromatids and the location of primary constrictions.

Male Meiotic Stages:

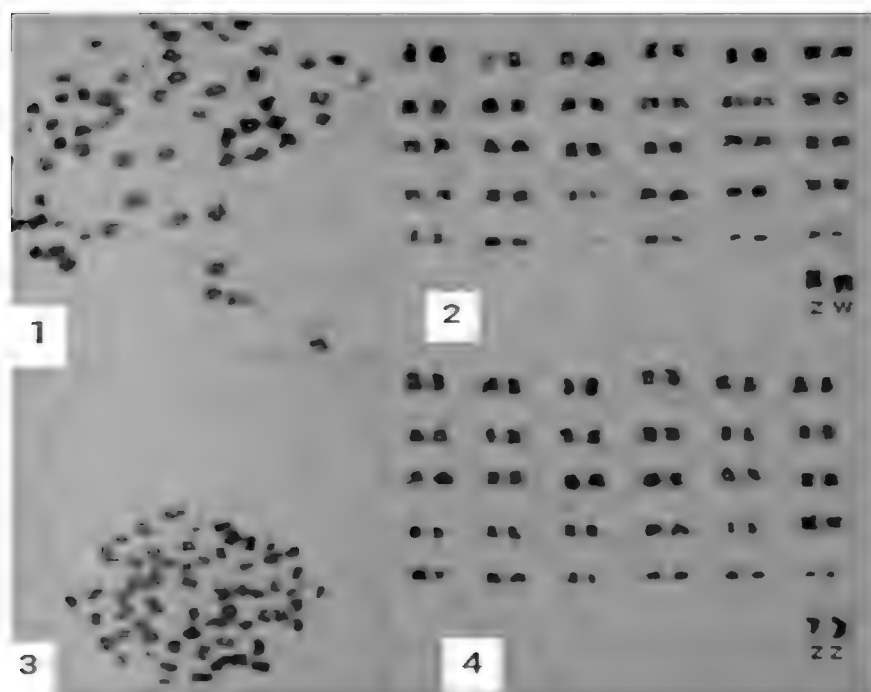
Diakinesis (Fig.7) reveals discrete chiasmata in each of the individual bivalents. The chiasma frequency per bivalent varies from 1 to 2. Metaphase I (Fig.9) proceeds with condensation of all the 31 bivalents. Dumbbell shaped bivalents are very clearly seen in the side view of prometaphase I (Fig.8). Metaphase II (Fig.10) reveals 31 univalents and confirms the haploid number of complement to be $n=31$.

Sex Chromatin (Fig.11):

A single darkly stained sex chromatin body found in the somatic interphase nucleus from brain cells of female *A. spinifera* depict the female to be the heterogametic sex with sex chromatin representing the W chromosome in the resting nucleus.

Discussion

Agrotis spinifera ($2n=62$) belongs to the family Noctuidae of insect order Lepidoptera. The most frequently occurring diploid number of this family is $2n=62$ which is clearly shown by the histogram given by Sahni (1997) depicting the frequency distribution of haploid chromosome numbers in 74 species of Noctuidae. Our present reports of female heterogamety obtained by modified method of *in vitro* colchicine treatment is in karyotypic consonance of the family Noctuidae (Rishi *et al.*, 2001). Sex chromosome mechanism with ZW:ZZ sex chromosome, has been confirmed from the karyotypable elements obtained from the male and female somatic metaphases. Female heterogamety has further been confirmed on the basis of heteropycnotic body



Figures1: Somatic metaphase chromosomes from brain cells of *Agrotis spinifera* female showing splitting of the chromatids($2n=62$); 2: Karyotype prepared from fig 1; 3: Somatic metaphase chromosomes from brain cells of *Agrotis spinifera* male showing splitting of the chromatids; 4: Karyotype prepared from fig 3.

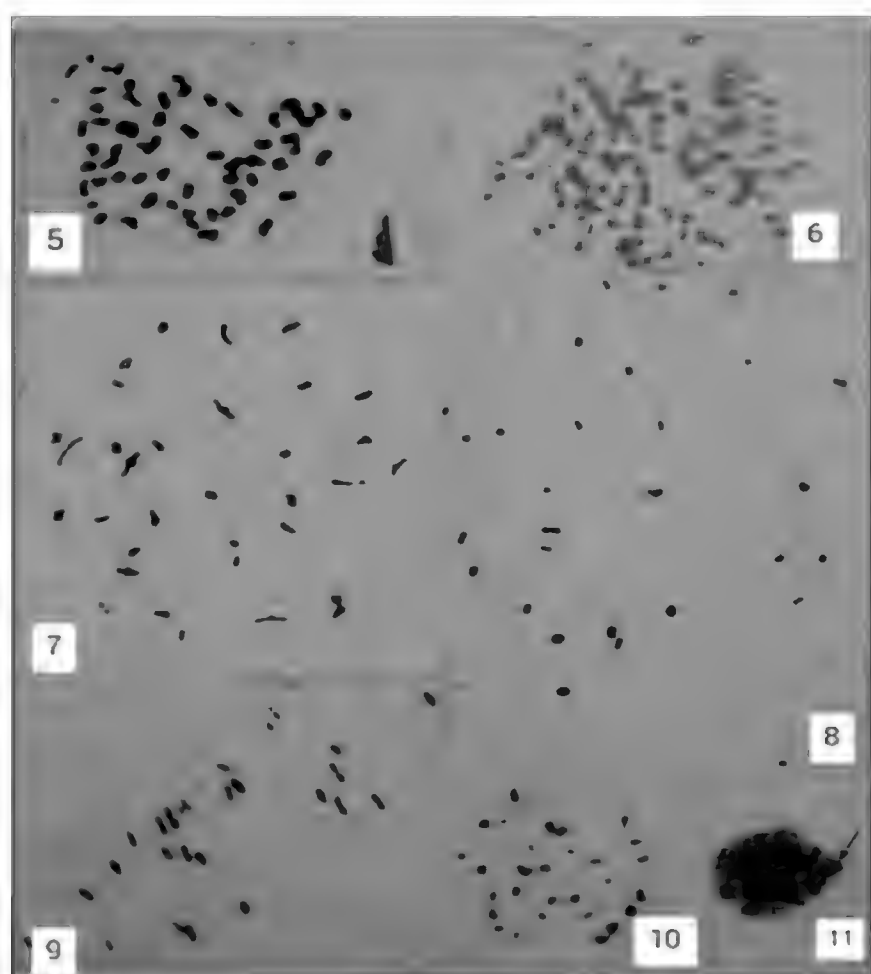


Figure 5: Spermatogonial mitotic metaphase of *Agrotis spinifera*; 6: Polyploid spermatogonial nucleus with most of the elements showing splitting of the chromatids; 7: Diakinesis of the male meiotic prophase; 8: Prometaphase I, $n=31$ (side view); 9: Metaphase I ($n=31$); 10: Metaphase II; 11: Female interphase nucleus with distinct heteropycnotic sex chromatin body

found in more than 70% of the somatic interphase nuclei of brain cells of female larvae. Occurrence of sex chromatin in the interphase nuclei of the heterogametic females of Lepidoptera has been found to correspond to the heteropycnotic W or Y chromosome (Marec and Traut, 1994; Rishi *et al.*, 1997). Recent molecular insights revealed the evolution of W chromosome in 3 species of Lepidoptera (Dalikova *et al.*, 2017) using comparative genomic hybridisation. Presently reported ZW:ZZ sex mechanism has been authenticated in a pyralid moth *Sylepta multilinealis* and a lemon butterfly, *Papilio demoleus* by successful application of a differential staining technique of G-banding (Dhawan, 2016).

Karyotypic evolution and sex determining mechanisms have been described in 29 orders of insects (Blackmon *et al.*, 2017). Both types of kinetic organisations-holokinetic as well as monokinetic have been claimed for Lepidoptera chromosomes (Bigger 1975, 1976). Our earlier reports of localized centromeres in *Ergolis merione*, *Papilio demoleus* and *Sylepta multilinealis* (Rishi *et al.* 1997, 2000; Dhawan 2016) are in consonance with the monokinetic organization of mitotic chromosomes of different species of *Pieris* (Bigger, 1976) and electron microscopic study of *Ephestia* and *Trichoplusia* chromosomes (Gassner and Klemetson, 1974). Present results of advanced spermatogonial metaphases revealed contracted chromosomes with a small proportion of obviously holokinetic chromosomes as evidenced by Bigger (1975) who suggested that early metaphase exhibit a monocentric type of organization but as metaphase proceeds, influence of primary centromere is either lost or superseded by the combined influence of the rest of the centromere. This fits into the idea of Traut (1986) who claimed the dual nature of Kinetochore organisation in Lepidoptera. The present discovery of distinct localised centromeres in early somatic metaphases of a noctuid moth, *Agrotis spinifera*, is thus extremely worth further investigation particularly with regard to the theories proposed in order to explain karyotypic evolution in Lepidoptera.

References

- Bigger, T.R.L. 1975. Karyotypes of some lepidopteran chromosomes and changes in their holokinetic organization as revealed by new cytological techniques. *Cytologia* 40: 713-726.
- Bigger, T.R.L. 1976. Karyotypes of three species of Lepidoptera including an investigation of B Chromosomes in *Pieris*. *Cytologia* 41: 261.
- Blackmon, H., Ross, L. and Bachtrog, D. 2017. Sex Determination, Sex chromosomes and Karyotype Evolution in Insects. *Journal of Heredity* 108(1): 78-93.
- Dalikova, M., Zrzava, M., Hladova, I. Nguyen, P., Šonský, I., Flegrová, M., Kubíčková, S., Voleníková, A., Kawahara, A.Y., Peters, R.S. and Marec, F. 2017. New insights into the evolution of the W Chromosome in Lepidoptera. *Journal of Heredity* 108(7): 709-719.
- Dhawan, G. 2016. Female heterogamety revealed by application of differential staining technique in a species of Lepidoptera. *International Journal of Applied and Natural Sciences* 5(4): 127-132.
- Gassener, G. and Klemetson, D.J. 1974. A transmission electron microscope examination of hemipteran and lepidopteran gonial centromeres. *Canadian Journal of Genetics and Cytology* 16: 457-464.
- Izumi, H. and Seto, T. 1995. Comparative karyology of two species of *Parnassius*: *P. glacialis* from Honshu and *P. stubbendorffii hoenei* endemic to Hokkaido, Japan (Lepidoptera, Papilionidae). *Kromosomo* 2 (78): 2683-2688.
- Kawazoe, A. 1992. Chromosomes of some univoltine moths in the cold season (3). *Chromosome Information Service* 53: 27-30.
- Maeki, K. 1981. On the W chromosome of the Butterfly, *Graphium sarpedon* (Papilionidae). *Proceedings of the Japan Academy* 57: 10.
- Marec, F. and Traut, W. 1994. Sex chromosome pairing and sex chromatin bodies in WZ translocation strains of *Ephestia kuehniella* (Lepidoptera). *Genome* 37(3): 426-435.
- Rishi, S. and Rishi, K.K. 1985. Somatic and meiotic chromosome analysis of *Danaus limniace* (Lepidoptera, Nymphalidae). *Chromosome Information Service* 39: 22-23.
- Rishi, S. and Rishi, K.K. 1990. A chromosomal study of *Pieris brassicae* L. (Lepidoptera, Pieridae). *Cytobios* 04: 203-207.
- Rishi, S., Sahni, G. and Rishi, K.K. 1997. Female heterogamety, localized centeromeres in *Papilio demoleus* Linn. (Lepidoptera, Papilionidae). *Chromosome Science* 1: 109-113.
- Rishi, S., Sahni, G. and Rishi, K.K. 1999. Inheritance of unusual sex chromosome evidenced by AA^WZ sex trivalent in *Trabala vishnu* (Lasiocampidae, Lepidoptera). *Cytobios* 53: 22-23.
- Rishi, S., Sahni, G. and Rishi, K.K. 2000. Karyological study in *Ergolis merione* Cram. (Nymphalidae: Lepidoptera) with indications of localized centeromeres and female heterogamety. *Entomon* 25(4): 313-322.
- Rishi, S., Sahni, G. and Rishi, K.K. 2001. Karyotypes of seven species of Indian Noctuid moths (Lepidoptera, Noctuidae). *Chromosome Science* 5: 39-46.
- Robinson, R. 1971. *Lepidoptera Genetics*. Oxford: Pergamon Press, 687 pp.
- Sahni, G. 1997. 'Chromosomal studies in some Indian Lepidoptera'. Ph.D thesis submitted to K.U., Kurukshetra, Haryana.
- Saitoh, K. 1989. Male germ-line chromosome of *Erebia nipponica nipponica* Janson, 1877 (Lepidoptera, Satyridae). *Nota Lepidopterologica* 12(3): 198-200.
- Suomalainen, E. 1969. Chromosome trivalent in some Lepidoptera females. *Chromosoma* (Berl.) 28: 298-309.
- Suomalainen, E. 1971. Unequal sex chromosomes in a moth, *Lozotaenia forsterana* F. (Lepidoptera: Tortricidae). *Hereditas* 08: 313-316.
- Traut, W. 1986. A genetic linkage study of W chromosome autosome fusions, breakage and kinetic organisation of chromosomes in *Ephestia* (Lepidoptera). *Genetica* 69: 69-79.

Description of a new species of *Megachalcis* Cameron (Hymenoptera: Chalcidoidea: Chalcididae) from India with a revised key to species

*P.M. Sureshan, P. Girish Kumar and C. Chares

Zoological Survey of India, Western Ghat Regional Centre, Kozhikode 673 006, Kerala, India.

(Email: pmsuresh43@gmail.com)

Abstract

A new species of *Megachalcis* Cameron (Hymenoptera: Chalcididae) is described based on the study of a female specimen collected from the Kannapuram mangroves of Kerala. A revised key to the species of *Megachalcis* is also provided.

Keywords: *Hymenoptera, Chalcididae, Megachalcis, new species, Key.*

Received: 29 May 2018; Revised: 11 October 2018; Online: 17 October 2018.

Introduction

The genus *Megachalcis* Cameron belongs to the tribe Cratocentrini of the subfamily Chalcidinae of the family Chalcididae (Hymenoptera: Chalcidoidea) which is currently known by 7 species described worldwide, distributed in south Asia from western India to eastern Indonesia (Narendran, 1989; Narendran & Achterberg, 2016; Noyes, 2018). *Megachalcis* specimens are very rarely encountered in collections and they are probably parasitoids of wood boring beetles, occurring in naturally rich rain-forest habitats and no actual host records are available till date (Bouček, 1988). The representative of the genus from India is *M. malabarica* Narendran, and the species was described by Narendran (1989) based on the type specimens collected from the campus of University of Calicut, Kerala, India, the vegetation of the locality is more or less a scrub jungle type. Studies on a female specimen collected from the mangroves (Fig. 10) of Kannur district of Kerala yielded one undescribed species which is described here. The key to species of *Megachalcis* published by Narendran, 1989 and Narendran & Achterberg, 2016 are modified here to accommodate the new species described.

Materials and Methods

The specimen of the present study was

collected using a sweep net over the inflorescence of a mangrove plant of *Avicennia* sp. from Kannapuram (11.5835°N & 75.1817°E) which is located in the Kannur district of Kerala. The specimen was preserved in 70% ethyl alcohol and card mounted for microscopic observation. It was examined under a stereoscopic binocular microscope of model LEICA M205 and the images were captured with the camera model LEICA DFC 500. Terminology used in the paper generally follows Narendran (1989) and the type specimens are deposited in the National Zoological collections of Zoological Survey of India, Western Ghat Regional Centre, Kozhikode (ZSIK). The present description is based on a single specimen since further efforts to collect more specimens did not yield any additional material due to the rare nature of the genus.

The following abbreviations are used in the text: AOL = Distance between anterior ocellus and posterior ocellus; F = Funicular segments; LOL = Diameter of anterior ocellus; MV = Marginal vein; OOL = Ocellocular distance; PMV = Postmarginal vein; POL = Postocellar distance; SMV = Submarginal vein; STV = Stigmal vein.

Results and Discussion

***Megachalcis* Cameron**

Megachalcis Cameron, 1903: *J. Straits Brch. R. Asiat. Soc.* 39: 96-97. Type species *Megachalcis fumipennis* Cameron, by monotypy.

Allocentrus Cameron, 1911: *Societas ent.* 26: 12. Type species *Allocentrus hirticeps* Cameron, by monotypy.

Macrochalcis Masi, 1944: *Ann.Mus.civ.Stor.nat. Giacomo Doria* 62:136-137. Type species *Macrochalcis bischoffi* Masi, by original designation.

Diagnosis : *Megachalcis* is characterized by a gaster in female produced in to a long tail , tergites 2 to 4 strongly reduced and for most part hidden under the large first tergite; PMV much longer than MV; mesosoma often with rasp-like sculpture and body with some silvery patches of hairs.

Hosts: Apparently parasites of wood-boring beetles on dead or fallen trees, but no host records are available (Boucek, 1988).

Distribution: Southeast Asia.

***Megachalcis kannapuramensis* Sureshan & Girish Kumar sp. n.**

(Figs. 1-9)

[urn:lsid:zoobank.org:act:8A24DB8A-9628-4B26-840A-7407462EA4A7](https://zoobank.org/urn:lsid:zoobank.org:act:8A24DB8A-9628-4B26-840A-7407462EA4A7)

Description: Holotype, ♀, length of body 12.5 mm (including 5.86 mm length of ovipositor sheath in profile view). Body black with the following parts as follows: eyes grey; tarsi liver brown. Wings hyaline with brownish tinge; veins dark brown; pubescence silvery.

Head (Figs. 1, 2 & 3): Head densely punctate, width in frontal view 1.75x its height (up to clypeal apex); POL 1.28x OOL; LOL 1.10x AOL; width between eyes in dorsal view 3.63x POL; occiput concave; pits on head large, mostly carinate; scrobe reaching anterior ocellus; median area of top of scrobe with few pubescence; malar space 0.49x eye height in profile; eye width 0.71x eye height in profile; eyes bare; preorbital carina absent; post orbital carina starting from malar space running upwards, not reaching geno-temporal margin; antenna (Fig. 4) inserted slightly below the level of ventral margin of eyes; scape not reaching

anterior ocellus. Relative length: width of antennal segments: scape 25: 6; pedicel 7: 5; anellus 3: 3.5; F1 to F6 almost equal length and width (8: 5); F7 = 7.5: 5; clava = 11.5: 5.5; clava 1.53x as long as preceding segment; scape densely setose ventrally.

Mesosoma (Figs. 1 & 5): Dorsal side of pronotum with close, deep pits, interstices mostly carinate, two distinct humps present sub medially on posterior marginal area; posterior margin of pronotum a little emarginated medially; mesoscutum and scutellum closely pitted, interstices carinate. Propodeum (Fig. 6) with large foveolae, plicae raised and carinate, spiracle bean-shaped, a distinct tooth on either side projecting to lateral side; propodeum with dense silvery large setae on either side, spread over to median part. Fore wing (Fig. 7) 5.39x as long as wide; relative length of SMV = 48.5; MV = 12; PMV = 31; STV = 5. Hind coxa without a dorso-basal tooth; hind femur (Fig. 8) twice as long as broad, ventral margin with a row of 12 teeth of different size; inner side of hind femur with a ventro-basal tooth; hind tibia with a deep smooth lengthy fovea from middle to apex on inner side.

Metasoma (Fig. 1 & 9): Metasoma (excluding ovipositor sheath) distinctly longer than mesosoma (48: 38); distance between apex of epipygium to tip of ovipositor sheath (in dorsal view) about as long as metasoma (63: 61.5).

Male: Unknown.

Material examined: Holotype ♀, INDIA: Kerala, Kannur district, Kannapuram mangroves (11.5835°N & 75.1817° E), 13.v.2018, Coll. C. Chares, ZSIK Regd. No. ZSI/WGRC/ IR/ INV/ 11417.

Host: Unknown.

Distribution: India: Kerala

Etymology: The species is named after the type locality.

Discussion: In the key to Oriental species of *Megachalcis* of Narendran, 1989, this new species comes close to *M. malabarica* Narendran in having an inner basal tooth on the hind femur and general morphology. However it

differs from *M. malabarica* in having: 1) distance between apex of epipygium to tip of ovipositor sheath (in dorsal view) about as long as metasoma (63: 61.5) (in *M. malabarica*, distance between apex of epipygium to tip of ovipositor sheath (in dorsal view) shorter than metasoma); 2) Pronotum with two submedian prominent convex areas (humps) (in *M. malabarica*, pronotum without submedian humps); 3) Pronotal side flange, tegulae and basal tergite black (in *M. malabarica*, pronotal side flange, tegulae and basal tergite reddish); 4) Body length (including ovipositor) 12.5 mm (in *M. malabarica*, body length (including ovipositor) 6.39-8.58 mm).

This new species also comes close to *M. vietnamensis* Narendran & Achterberg, 2016 in general morphology and having an inner basal tooth at the hind femur and general morphology. However, it differs from *M. vietnamensis* in having: 1) distance between apex of epipygium to tip of ovipositor sheath (in dorsal view) about as long as metasoma (63: 61.5) (in *M. vietnamensis*, distance between apex of epipygium to tip of ovipositor sheath (in dorsal view) distinctly longer than metasoma (56: 44); 2) Hind coxa without a dorsal tooth (in *M. vietnamensis*, hind coxa with a dorsal tooth); 3) Fore wing 5.39x as long as wide (in *M. vietnamensis*, fore wing 3.3x as long as wide); 4) Apical margin of first tergite and sternites black (in *M. vietnamensis*, apical margin of first tergite and sternites pale brown).

Key to species of *Megachalcis* Cameron

(based on females; modified from Narendran, 1989 and Narendran & Achterberg, 2016)

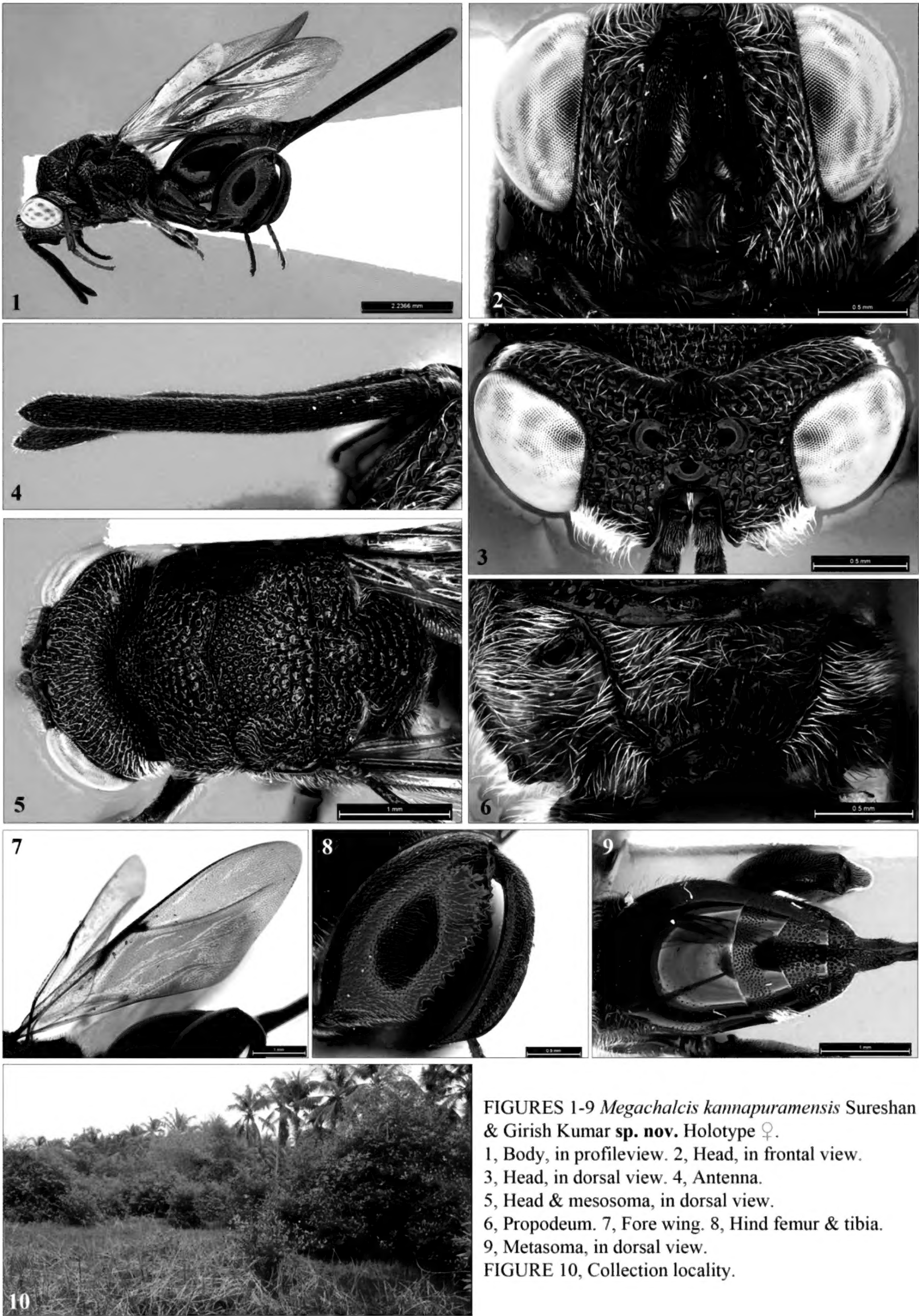
1. Hind femur with an inner basal tooth present.....2
 - Hind femur without inner basal tooth.....4
2. Hind coxa with a dorsal tooth; distance between apex of epipygium to tip of ovipositor sheath (in dorsal view) longer than metasoma (56: 44).....*M. vietnamensis* Narendran & Achterberg
 - Hind coxa without a dorsal tooth; distance between apex of epipygium to tip of ovipositor sheath (in dorsal view) about as long as or shorter than metasoma.....3

3. Pronotum with two submedian prominent convex areas (humps); distance between apex of epipygium to tip of ovipositor sheath (in dorsal view) about as long as metasoma; pronotal side flange, tegulae and basal tergite black; body size 12.5mm (including ovipositor).....*M. kannapuramensis* Sureshan & Girish Kumar sp. n.
 - Pronotum without submedian convex areas (humps); distance between apex of epipygium to tip of ovipositor sheath (in dorsal view) shorter than metasoma; pronotal side flange, tegulae and basal tergite reddish; body size 6.39-8.58mm (including ovipositor).....*M. malabarica* Narendran
4. Apex of scutellum arcuate; basal areoles of propodeum of uniform size and apical cells not interrupted by median carina (see Fig. 222 of Narendran, 1989) except at extreme ends; pronotum always with two convex areas (humps).....5
 - Apex of scutellum projecting angularly; basal areoles of propodeum not as above (see Fig. 224 of Narendran, 1989); pronotum not always with two prominent convex areas (humps).....7
5. Wings uniformly infumated; pronotal convex areas well developed; first gastral tergite smooth.....*M. fumipennis* Cameron
 - Wings hyaline; pronotal convex areas not well developed as in alternate; first gastral tergite sparsely pitted.....6
6. Body unusually pubescent, much longer than in alternate with a longer ovipositor (body 16 mm with ovipositor 26mm); propodeum with a median tooth.....*M. timorensis* Bouček
 - Body not unusually pubescent, not as large as in alternate, with shorter body (7mm without ovipositor); propodeum without a median tooth.....*M. secundaria* (Masi)
7. Forewing uniformly infumated; pronotal convex humps less developed than in alternate; scapulae and axillae moderately convex; propodeum with proximal dent more robust than distal dent; hind tibia unpolished, mat, hollow depression with a number of almost contiguous pits; antenna black.....
 -*M. hirticeps* (Cameron)
 - Forewing greatly infumated at base than at apex; pronotal convex humps well developed; scapulae and axillae moderately

Description of a new species of *Megachalcis* Cameron from India

convex; propodeal distal dent more robust than proximal; hind tibia shiny, hollow

depression with minute sparse pits.....
.....*M. carinata* (Steffan)



Acknowledgements

We are grateful to Dr. Kailash Chandra, Director, Zoological Survey of India, Kolkata for providing facilities and encouragement.

References

- Bouček, Z. 1988. Australasian Chalcidoidea (Hymenoptera). A biosystematic revision of genera of fourteen families with a reclassification of species. Aberystwyth, Wales: CAB International, Wallingford, Oxon, U.K., Cambrian News Ltd. 832 pp.
- Cameron, P. 1903. Descriptions of new genera and species of Hymenoptera taken by Mr. Robert Shelford at Sarawak, Borneo. Journal of the Straits Branch of the Royal Asiatic Society 39: 89-181.
- Cameron, P. 1911. Descriptions of new genera and species of Chalcididae collected by Mr. John Hewitt, B.A. in Borneo. Societas entomology 26: 3-4, 7-8, 11-12, 14, 19, 23-24, 28.
- Masi, L. 1944. Materiale per Lo studio di due generi di Brachymeriinae: *Cerachalcis* Schmied. in litt.e *Macrochalcis* n.(Hymen, Chalcididae). Annali del Museo civico di Storia naturale Giacomo Doria 62: 112-19.
- Narendran, T.C. 1989. Oriental Chalcididae (Hymenoptera: Chalcidoidea), Zoological Monograph. Department of Zoology, University of Calicut, Kerala, India. 441 pp.
- Narendran, T.C. & van Achterberg, C. 2016. Revision of the family Chalcididae (Hymenoptera: Chalcidoidea) from Vietnam, with the description of 13 new species. Zookeys 576: 1-202. Doi: 10.3897/zookeys,576.8177
- Noyes, J.S. 2018. Universal Chalcidoidea Database. World Wide Web electronic publication <http://www.nhm.ac.uk/chalcidoids>. Last updated March, 2018.